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# Age Changes in Relation to the Ingestion of Milk, Water, Coffee, and Sugar Solutions

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DURING the winter of 1946-1947 an experiment was started to determine the effect of two widely different levels of liquid ingestion upon the life span of white rats. Four groups of rats, containing 58 or 60 each, were used. As far as possible distribution among the groups was made on the basis of litter mates and sex.

From weaning until natural death one group was fed pasteurized, fresh cow's milk supplemented three times each week with the following amounts of trace elements per 100 ml. of total milk consumed: Mn, 1.5 mg. as $MnCl_2.4H_2O$; Cu, 0.8 mg. as $CuSO_4.5H_2O$; Fe, 5.0 mg. as $FeCl_2.6H_2O$; and I, 2 drops of a 2 per cent solution of KI. The only other supplement was 4 drops of cod liver oil given twice weekly. This diet of fresh milk was fed from graduated tubes containing 100 ml. Such a diet forces the rat to ingest a large volume of fluid in order to obtain its requirements in calories and essential nutrients.

The second group of rats was given a 10 per cent solution of sucrose in water to drink. Past experience has indicated that such rats drink several times their daily water requirements under such conditions because of their fondness for sweet solutions. These rats were allowed all they wished of the stock diet used in our laboratory. This diet has been extensively tested and found complete for both dogs and rats. It consists of the following mixture: corn flakes, 17.875 per cent; wheat flakes, 5 per cent; dried bread supplemented with 15 per cent of its weight of high grade tallow, 25 per cent; meat scraps, 23 per cent; heat treated, low-fat soy meal, 6.5 per cent; wheat germ, 7 per cent; tomato pomace, 2 per cent; dry skim milk, 4 per cent; cheese meal, 1.5 per cent; fish meal, 1.5 per cent; alfalfa meal, 1.5 per cent; dried brewer's yeast, 2.0 per cent; liver meal, 2.0 per cent; dicalcium phosphate, 0.75 per cent; sodium chloride, 0.2 per cent; vitamins A-D concentrate, 0.075 per cent; and irradiated yeast, 0.1 per cent.

The third group of rats known as the "coffee" group were given only coffee as a beverage. They were fed the same stock diet to which was added an equal weight of sucrose in order to make comparison possible with those drinking sucrose solutions. The coffee was brewed fresh each day and made in the usual strength consumed by man.

The fourth group known as the water group was fed like group 3 given the coffee but was given tap water instead.

## TECHNIQUES OF STUDY

Rats were kept in an air conditioned room until they died a natural death. In the course of their lives some determinations were made for typical subgroups of the amounts of food and liquid consumed by individuals of opposite sex. Some blood counts were made to learn if any were anemic. Careful observations were made of the excreta.

At the time of death, rats were dissected and typical samples of tissue placed in Zenker's fluid for shipment to the pathology laboratory. The heads were shipped for study by a dentist. X-ray photographs were made of soft tissues to detect calcification. Both humeri were dissected free of flesh in order to determine the ash, calcium, volume, and density. Weight records were kept throughout life so that the age of maximum body weight could be deter-

mined. Typical subgroups were used for chemical balance studies during various periods of life. Sodium, chloride, and calcium balances were run.

## Growth

Rats were weighed at regular intervals. The curves for 10 rats of each sex from each group of 60 were plotted on the special log-reciprocal paper devised by Zucker and associates (8). Only exceptional individuals from each group had growth curves that fitted the straight line of Zucker. The trend of most animals was to grow at a slower rate during the first three months after weaning and at a somewhat higher rate after three months of age.

Due to the introduction of sugar into the diets of 3 groups, the diet contained about 14 per cent of the calories as protein. This protein of the stock diet originated from a mixture of meat, milk, and plant proteins. Milk contains 20 per cent of its calories in the form of protein. Furthermore this milk protein is known to be about a fifth better utilized than that in the stock diet. For these reasons it was anticipated that the curves for the rats fed exclusively upon milk might have approached the straight line of Zucker more closely than those fed the stock diet diluted with sugar. However no differences were found. This indicates that the stock diet diluted with half its weight of sucrose permits the same growth as milk.

Since growth curves differed little, it was only considered worth while to present some typical data of body weights at three ages and the maximum body weights attained by each sex and group (table 1).

The mean of the maximum body weights attained by each group reveals no difference between those drinking coffee and water. If some individual or the entire group had been rendered nervous by the constant ingestion of coffee the maximum body weight might have been expected to be lower than the comparable value for water. There was no difference in the case of females and an insignificant one in the case of males.

Table 1. Mean Weight in Grams and Probable Error of the Mean for Rats at Different Ages and the Maximum Body Weight.

| Liquid Ingested | Age 100 Days | Age 200 Days | Age 300 Days | Maximum Attained |
|---|---|---|---|---|
| | | Females | | |
| | gm. | gm. | gm. | gm. |
| Coffee | 197±3.4 | 258±5.1 | 286 | 290±7.4 |
| Sugar | 207±3.8 | 260±4.6 | 284 | 300±9.0 |
| Water | 211±4.0 | 263±6.6 | 281 | 290±6.9 |
| Milk | 184±2.9 | 237±3.2 | 253 | 275±4.7 |
| | | Males | | |
| Coffee | 243±5.1 | 363± 8.6 | 408 | 405±9.4 |
| Sugar | 306±7.4 | 403±10.6 | 436 | 455±8.9 |
| Water | 264±3.6 | 367± 8.9 | 411 | 425±9.0 |
| Milk | 245±5.7 | 358± 4.0 | 380 | 372±6.8 |

Two significant trends are evident between both sexes fed milk and sugar solutions. The lowest body weights were found for both sexes fed only milk while the highest body weights were attained by those fed the 10 per cent sucrose solution. In both cases these differences must reflect the degree of body fatness since the volume and weight of a typical bone from each rat, namely the humerus, was the same in mean value for similar sexes of each of the 4 groups.

Milk tended to maintain bodies with the least amount of adipose tissue while the drinking of sugar solutions produced the fattest rats. As nearly as possible the amount of sugar ingested by rats drinking water and coffee was adjusted to the amount drunk by those given the 10 per cent sugar solution. For some reason the drinking of sucrose solutions must either stimulate the rat to consume slightly more available calories or the sugar in solution may have improved the efficiency of utilization of the calories in the diet.

The difference was most marked among the groups of males. Even though the accumulation of body fat by those drinking sucrose

solutions was substantial, the deposit was made during a period of five hundred days. To effect this addition of fat each male rat needed to consume enough additional food to provide a half calory per day. Since the value for calories ingested per day by the average male was slightly less than twenty this indicates that about 2.5 per cent more food must have been eaten by the average male drinking sucrose solutions than by the male drinking coffee or water. The same result could have been attained if the food conversion were a fortieth better in one group compared to the other. Since litter mate distributions were used for all groups these differences must be nutritional rather than genetic.

Since the body weights were about as far below the values for those drinking coffee and water as the other group was above, the calory consumption of the milk-fed rats must have been about 5 per cent below those drinking sugar solutions. These extremes occured between those drinking milk and sucrose solutions.

During the last third of the life span of rats there is usually a decline in weight, which becomes very marked as the end of life draws near. This decline is probably associated in most cases with the increased severity of bronchitectasis as the animals ages.

### Life Span Related to Skeletal Volume and to Maximum Body Weight

Earlier studies with rats have indicated that keeping the body thin during either the whole life or during the latter half of life increases the total span of life. Keeping the body thin either by exercise or restriction of calories during the latter half of life is favorable (4).

However there are no data in the literature to determine if the attainment of a large body size within a species is favorable or unfavorable to total span of life. The current experiments afforded two opportunities to study the correlation between maximum body size attained and total span of life. In the first case maximum body weight affords a criterion of size but is confused by variations in degree of body fatness.

In order to have a better criterion the volume of a typical bone was selected. The two humeri from each rat were dissected free of flesh. They were then extracted with ether to free them from fat. After this they were coated with a thin layer of zein by immersing them briefly in an alcoholic solution of this protein. After drying, the bones were weighed in air and then in water. From these data the volume of each bone could be calculated.

A study of adults was made to test the possible relationships between the total span of life and the maximum body weights attained by the two sexes. The frequency tables indicated that the greater the maximum body weight attained, the longer the span of life. Correlation coefficients were calculated according to the method described by Love (3). The r values for males and females respectively were $0.482 \pm 0.05$ and $0.64 \pm 0.08$. These indicate a significant positive relationship between maximum body weight and length of life.

Animals that tended to attain the greatest body weights at some period in life tended to have the longest span of life. No similar data for other species have been discovered in the literature.

Since body weight may indicate either or both the amount of adipose tissue and the true size, correlation studies were also made between the volume of the humerus, representing the size of the skeleton and the span of life.

Since data concerning the volume of the humeri of adult rats are not available in the literature, the grouped data in relation to age are presented in tables 2 and 3. The correlation coefficients for males and females were respectively: $r = .58 \pm .058$ and $.40 \pm .065$.

These significant correlations indicate that the larger the rat grew, the longer was the span of life. Such data must be segregated on the basis of sex or no relationship is evident because the female sex grows to a smaller adult size and lives longer than the male. Hence if the two sexes are combined for correlation studies the relationships between max-

imum body size and span of life are obscured.

These results may be similar to those observed in the American population today. The mean size of both sexes is increasing and the life span is also growing longer. In the case of these experimental animals there is another possibility that the bones of the rats may increase slowly in volume as long as the rat lives. Therefore it is possible that the greater span of life would merely afford more time for increased bone volume. However this latter does not seem likely.

In our x-ray studies on tibia length it has been found that the tibias of males grow for a longer period than do those of females.

### Volume of Fluid Consumed

The plan of the experiment provided two very high levels of liquid ingestion, namely, in the form of fresh milk and 10 per cent sucrose solution. For comparison moderate levels of liquid were provided in the form of water in one case and coffee in the other.

The liquid ingested was measured at regular intervals of fifty days starting when the animals were fifty days old. Twelve to 14 individual rats of each sex were chosen from the larger groups for these measurements. All data were calculated to mean values in terms of milliliters consumed per day per 100 gm. of live weight (tables 4, 5).

The data of table 4 indicate the decline in the consumption of liquids that takes place between the ages of 50 and 550 days. Since all of the members of the subgroups were not alive at 550 days of age, data are presented for those that survived and those that perished relatively early in the span of life. The data show no significant differences. This indicates that there was no marked relationship between habits in the amount of liquid consumed and premature death.

Table 2. Grouped Data for Volume of the Humerus and the Age at Death. (Males). $r = 0.58 \pm .058$.

| Age (Days) | Volume in Cubic Millimeters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 230-9 | 240-9 | 250-9 | 260-9 | 270-9 | 280-9 | 290-9 | 300-9 | 310-9 | 320-9 | 330-9 |
| 340-59 | 1 | | | | | | | | | | |
| 360-79 | | | | | | | | | | | |
| 380-99 | 1 | | | | | | | | | | |
| 400-19 | 1 | 2 | 2 | 1 | | | 1 | | | | |
| 420-39 | | | | | | | | | | | |
| 440-59 | | | | | | 1 | | | | | |
| 460-79 | | | | | | 2 | | | | | |
| 480-99 | 1 | | 1 | | | | | | | | |
| 500-19 | | | | | | | | | | | |
| 520-39 | 1 | | 1 | | 1 | | | | | | |
| 540-59 | | | 1 | | 1 | 2 | 1 | | | | 1 |
| 560-79 | | | | 2 | | | 1 | | | | |
| 580-99 | | | | | | | | | | | |
| 600-19 | | 2 | | | | 1 | | 1 | | | |
| 620-39 | | | | 1 | 1 | | | 1 | | | |
| 640-59 | | 1 | | | 1 | 2 | | | | | |
| 660-79 | | | | | | 1 | 2 | 1 | | | |
| 680-99 | | 1 | | | | | | 1 | 1 | | |
| 700-19 | | | | 1 | | | 1 | 2 | | 1 | 1 |
| 720-39 | | | | | | 1 | | 1 | 1 | | |
| 740-59 | | | 1 | | 1 | | | 1 | | | |
| 760-79 | | | | | | | | | | | |
| 780-99 | | | | | | | 1 | 1 | | | |

TABLE 3. GROUPED DATA FOR VOLUME OF THE HUMERUS AND THE AGE AT DEATH. (FEMALES). $r = .40 \pm .065$.

| Age (Days) | Volume in Cubic Millimeters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 160-9 | 170-9 | 180-9 | 190-9 | 200-9 | 210-9 | 220-9 | 230-9 | 240-9 | 250-9 | 260-9 |
| 400-19 | 1 | | 1 | | | 1 | | | | | |
| 420-39 | | | | | | | | | | | |
| 440-59 | | 1 | | | | | | | | | |
| 460-79 | | | | | 1 | | | | | | |
| 480-99 | | | | 1 | 1 | | | | | | |
| 500-19 | | | 1 | | | 1 | | | | | |
| 520-39 | | | | 1 | 1 | 1 | | | | | |
| 540-59 | | | | | 1 | | | | | | |
| 560-79 | | | 1 | | 1 | | | | | | |
| 580-99 | | 1 | | | | 1 | | | 1 | | |
| 600-19 | | | | | | | | 1 | | | |
| 620-39 | | | | | | 1 | 1 | | | | |
| 640-59 | | | | 1 | | 2 | | | | | 1 |
| 660-79 | | 1 | 1 | 1 | | | | | | | |
| 680-99 | | | | 2 | 2 | | 1 | 1 | | | |
| 700-19 | | | | 1 | 2 | 1 | | | | | |
| 720-39 | | | | | 2 | 1 | 1 | | | | |
| 740-59 | | | 2 | | 2 | 1 | 5 | | | | |
| 760-79 | | | | | | 2 | | | | | |
| 780-99 | | | | | | | | 1 | | | |
| 800-19 | | | | 2 | 1 | 1 | | | | | |
| 820-39 | | | | | | | 1 | | | | |
| 840-59 | | | | | 1 | 1 | 1 | | | | |
| 860-79 | | | | | | | | | | | |
| 880-99 | | | | | 1 | | 1 | | | | |
| 900-19 | | | 2 | | | 2 | | | | | |
| 920-39 | | | 1 | | | | | 1 | | | |
| 940-59 | | | | | | | 2 | | | | |
| 960-79 | | | | | | | 1 | | | | |

In the case of those given sucrose solutions there is relatively little decline, indicating that the rats did not lose their enthusiasm for the sweet beverage even though they drank approximately three times enough to satisfy their water requirements every day. Earlier studies had indicated that rats only decrease their consumption of sweet solutions containing sucrose if they are fed diets deficient in such essentials as calcium (5).

Since rats drank only about 10 per cent more of the coffee solution than they did of water there seems to be little evidence that coffee exercised a diuretic effect.

The sex differences observed in the data of both tables are marked and significant for all liquids. From the age of 100 days the females consumed more liquid than the males in all groups per unit of body weight. As a result of this difference the females drank more calories in the form of both milk and sucrose solution. In the case of the sucrose solution the females might have compensated to a lower daily intake of calories by eating less food but this was not possible in the group that ingested all its food in the form of milk. Even at the age of 50 days the females consumed more milk per unit of body weight.

These data upon milk indicate that the female ingested more calories consistently throughout life. The question is raised if this can be a reflection of a higher basal metab-

TABLE 4. AMOUNTS OF FLUID CONSUMED BY AVERAGE MEMBERS OF TYPICAL GROUPS OF RATS AT DIFFERENT AGES AND BY AVERAGE MEMBERS SURVIVING TO 550 DAYS (MILLILITERS PER 100 GM. BODY WEIGHT PER DAY.)

| Age (Days) | | Water | | Coffee | | Sucrose | | Milk | |
|---|---|---|---|---|---|---|---|---|---|
| | | Male | Female | Male | Female | Male | Female | Male | Female |
| 50 | All | 9.3 | 9.3 | 7.4 | 8.5 | 23.2 | 21.3 | 41.5 | 49.0 |
| | 550 | ... | 8.9 | ... | 8.0 | 26.8 | 21.3 | 40.9 | 47.8 |
| 100 | All | 6.7 | 8.3 | 7.2 | 8.1 | 24.2 | 81.0 | 34.8 | 37.6 |
| | 550 | 7.3 | 8.0 | 6.7 | 8.2 | 22.5 | 17.7 | 35.0 | 37.6 |
| 200 | All | 6.2 | 8.1 | 6.7 | 8.4 | 21.0 | 20.2 | 29.3 | 37.6 |
| | 550 | 6.2 | 8.0 | 6.2 | 8.4 | 21.7 | 21.8 | 28.4 | 37.1 |
| 300 | All | 5.1 | 7.0 | 6.2 | 8.1 | 18.6 | 21.4 | 27.2 | 37.2 |
| | 550 | 5.2 | 6.9 | 6.0 | 8.4 | 18.2 | 23.4 | 26.1 | 36.5 |
| 400 | All | 4.6 | 6.7 | 5.8 | 7.8 | 18.8 | 21.4 | 25.9 | 37.0 |
| | 550 | 5.0 | 7.0 | 5.8 | 8.2 | 16.8 | 21.4 | 25.1 | 36.4 |
| 500 | All | 5.1 | 6.9 | 5.6 | 8.4 | 15.2 | 19.8 | 23.7 | 34.5 |
| | 550 | 5.5 | 6.9 | 5.5 | 8.6 | 16.1 | 19.8 | 23.7 | 34.9 |
| 550 | | 6.0 | 6.7 | 5.3 | 7.6 | 17.9 | 22.3 | 24.4 | 32.9 |

TABLE 5. FLUID CONSUMED (ML.) PER 100 GM. LIVE WEIGHT PER RAT PER DAY AT AGES OF 6 MONTHS, 1 YEAR, AND 550 DAYS. (MEAN AND P. E.)

| Fluid | Males | | | Females | | |
|---|---|---|---|---|---|---|
| | Milliliters | | | Milliliters | | |
| | 6 Months | 1 Year | 550 Days | 6 Months | 1 Year | 550 Days |
| Water | 6.2±0.8 | 4.8±0.5 | 6.0±1.2 | 8 ±0.9 | 7 ±0.8 | 6.7±1.4 |
| Coffee | 7.1±0.9 | 5.8±0.6 | 5.3±0.8 | 8.6±1.0 | 8.1±0.7 | 7.6±1.4 |
| Sucrose Solution | 21.8±4.1 | 19.4±3.9 | 17.9±3.2 | 24.0±3.8 | 21.8±3.3 | 22.3±5.5 |
| Milk | 28.7±1.8 | 27.2±2.0 | 24.4±1.3 | 37.6±2.6 | 37.3±2.0 | 32.9±2.0 |
| Calories | | | | | | |
| Milk | 19.8 | 18.8 | 16.9 | 25.9 | 25.7 | 22.7 |
| Sucrose | 8.7 | 7.8 | 7.2 | 9.6 | 8.7 | 8.9 |

olism in the female than is found in the male rat. Will (7) found the female did have a higher resting metabolism than the male although there are other conflicting data in the literature (1).

These results may have some bearing upon the span of life but not from the conventional viewpoint. It is often stated that women outlive men because the female sex has a lower basal metabolism and hence women consume less fuel per unit of time. This explanation of lowered fuel utilization and hence longer span of life cannot hold in the case of the rat. In other species such as the dog there is no sound evidence that the female has a lower resting metabolism. Hence explanation for the reasons for sex differences in span of life must be sought in other areas of knowledge.

In the case of female rats fed a diet of fresh milk Brody found a resting metabolism of 6.2 calories per 100 gm. of live weight per day. On a solid food Will found values of 8.2 for males and 8.9 for females.

The calories consumed per day for both

sexes can be calculated at any age. These data for three different ages are given at the bottom of table 5. These data indicate that rats on the milk diet expended three to four times as much energy each day as they used for resting metabolism. In the case of man this ratio is only about two to one.

These factors may all play some part in determining the span of life but they cannot follow the patterns considered plausible in the past.

### Length of Life

The life span of individuals is shown in table 6. These are summarized in table 7 along with the data upon mean maximum weight attained by the opposite sexes in each group.

No significant differences have been found in relation to liquid ingested. The very high level of liquids in the group consuming milk and sugar solutions seems to have no special influence upon the span of life.

These data afford no evidence that a low level of liquid ingestion might have had an unfavorable effect. Even the groups drinking coffee and water consumed as much fluid per unit of body weight as a person drinking two quarts daily.

These data confirm earlier work in indicating no injury from the regular consumption of substantial amounts of coffee (6). Likewise there is no evidence for injury from drinking large amounts of sugar solution if the basal diet is adequate as it is in this case.

The rats fed no other food than liquid milk had the same mean span of life as those fed the mixed diet containing meat, cereal, and many other ingredients. This indicates that milk must be a complete food in all essentials except the four trace inorganic elements and some cod liver oil that were added. It must contain a minimum requirement of vitamins, essential amino acids, and essential lipids that are needed by the rat throughout life. Therefore it is unlikely that any organic essential for the rat will be discovered that is not found in pasteurized cow's milk. It is recognized that such milk has lost its ascorbic acid but the rat seems able to synthesize adequate amounts of this essential except under unusual conditions such as a great excess of dietary vitamin A.

Table 6. Age at Death in Days

| Water | | Coffee | | Sugar Solution | | Milk | |
|---|---|---|---|---|---|---|---|
| Female | Male | Female | Male | Female | Male | Female | Male |
| 372 | 263 | 109 | 86 | 320 | 355 | 307 | 118 |
| 401 | 343 | 359 | 317 | 330 | 378 | 356 | 139 |
| 414 | 344 | 411 | 325 | 369 | 383 | 383 | 159 |
| 443 | 346 | 452 | 330 | 493 | 399 | 396 | 341 |
| 467 | 364 | 453 | 358 | 515 | 403 | 438 | 350 |
| 468 | 385 | 460 | 363 | 520 | 406 | 460 | 375 |
| 480 | 405 | 464 | 391 | 523 | 411 | 464 | 406 |
| 568 | 411 | 468 | 393 | 525 | 425 | 476 | 407 |
| 573 | 416 | 475 | 398 | 527 | 425 | 487 | 425 |
| 585 | 439 | 482 | 422 | 559 | 429 | 519 | 457 |
| 592 | 448 | 496 | 451 | 592 | 480 | 533 | 492 |
| 598 | 457 | 514 | 464 | 596 | 483 | 543 | 516 |
| 617 | 457 | 524 | 467 | 645 | 507 | 561 | 520 |
| 625 | 463 | 578 | 527 | 685 | 525 | 564 | 526 |
| 647 | 512 | 587 | 556 | 697 | 525 | 568 | 535 |
| 653 | 540 | 663 | 560 | 703 | 541 | 647 | 552 |
| 662 | 549 | 678 | 576 | 725 | 546 | 648 | 557 |
| 663 | 554 | 681 | 578 | 746 | 555 | 664 | 571 |
| 683 | 554 | 690 | 594 | 747 | 562 | 700 | 580 |
| 768 | 557 | 692 | 607 | 748 | 572 | 710 | 598 |
| 805 | 587 | 736 | 611 | 753 | 580 | 714 | 598 |
| 806 | 600 | 738 | 644 | 760 | 605 | 735 | 602 |
| 808 | 631 | 742 | 652 | 771 | 617 | 751 | 627 |
| 810 | 639 | 749 | 700 | 786 | 627 | 753 | 675 |
| 840 | 666 | 750 | 704 | 786 | 646 | 753 | 677 |
| 915 | 685 | 813 | 723 | 848 | 656 | 832 | 681 |
| 931 | 705 | 830 | 750 | 888 | 660 | 921 | 710 |
| 961 | 726 | 845 | 754 | 903 | 683 | 944 | 712 |
| | 729 | 916 | 791 | 910 | 718 | 951 | 750 |
| | | | 796 | | | | |

### Calcium Balances upon Adult Rats and the Influence of Fluid upon the Path of Excretion

During the latter half of life the maintenance of calcium balance becomes more difficult in the older rat (2). In order to determine if the amount of liquid ingested influenced the calcium balance or the paths of excretion of calcium, three successive chemical balances

TABLE 7. LIFE SPAN AND MAXIMUM BODY WEIGHT ATTAINED.

| Liquid Ingested | Mean Age at Death and P. E. of Mean | Mean Maximum Weight and P. E. of Mean |
|---|---|---|
| | Males | |
| | (Days) (Days) | (Gm.) (Gm.) |
| Water | 509 ± 16.19 | 425 ± 9.03 |
| Milk | 502 ± 21.06 | 372 ± 6.79 |
| Coffee | 530 ± 21.04 | 405 ± 9.44 |
| Sugar | 521 ± 9.48 | 455 ± 8.94 |
| | Females | |
| Water | 648 ± 21.28 | 290 ± 6.89 |
| Milk | 613 ± 22.07 | 275 ± 4.66 |
| Coffee | 598 ± 22.1 | 290 ± 7.39 |
| Sugar | 654 ± 20.5 | 300 ± 9.0 |

were run. In each of these, 4 typical rats were selected from each of the major groups. Thus chemical balances were made upon a total of 12 different rats from each of the 4 groups. Collections were made for ten days after a four day preliminary period to accustom the rats to the metabolism cages.

Essential data are summarized in table 8. These data present values for the mean and probable error as well as the extremes. Extreme values seem more important in long time studies than in short ones since they may reflect the great variations that take place among individual animals. These extreme activities such as the large or small daily ingestion of fluid throughout life may have a profound influence on the chronic diseases that appear in later life.

The summary table indicates that the calcium ingested per day by the rats on the milk diet amounted to only about half as much as that ingested by rats on the mixed feed. In both cases the level was more than adequate to keep even old rats in positive balance.

These data indicate that even old rats may continue to store small amounts of calcium when the diet contains high levels. In the present case the rats on the diet other than milk derived most of the calcium from the bone meal of the diet.

The path of excretion of calcium was influenced both by the amount of fluid and by the diet of fresh milk. More calcium was excreted through the urine in the case of the rats ingesting sucrose solution and a large volume of liquid daily. These rats excreted about 4 mg. daily of calcium through the kidneys. This was double that excreted by the rats drinking lower levels of fluid in the

TABLE 8. PATHS OF EXCRETION OF CALCIUM BY OLD RATS IN RELATION TO DIET AND VOLUME OF FLUID INGESTED (VALUES PER DAY).

| | Milk | | | Sucrose | | | Coffee | | | Water | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | P. E. | Range | Mean | P.E. | Range | Mean | P. E. | Range | Mean | P. E. | Range |
| Age Range (Days) | 546 | .. | 418-740 | 545 | .. | 421-754 | 544 | .. | 441-668 | 551 | .. | 415-735 |
| Intake | | | | | | | | | | | | |
| Liquid (ml.) | 88 | 11 | 49-100 | 51 | 15 | 29-90 | 24 | 4 | 11-30 | 24 | 3.6 | 12-30 |
| Ca (mg.) | 109 | 13 | 60-124 | 270 | 74 | 104-475 | 206 | 39 | 103-321 | 212 | 50 | 151-334 |
| Urine Vol. (ml.) | 58 | 8 | 28-68 | 32 | 13 | 13-68 | <7 | .. | <7-14 | <7 | .. | <7-12 |
| Dry Feces (mg.) | 880 | 148 | 384-1147 | 2058 | 547 | 639-3197 | 1609 | 435 | 210-2495 | 1779 | 372 | 816-2742 |
| Ca in Urine (mg.) | 11 | 3.8 | 5-25 | 4 | 2 | 0-11 | 2 | 0.5 | 1-3 | 2 | 0.9 | 0-5 |
| Ca in Feces (mg.) | 80 | 9 | 45-98 | 192 | 43 | 127-306 | 180 | 36 | 126-279 | 179 | 43 | 61-265 |
| Ca Balance (mg.) | +18 | .. | −2-+31 | +73 | .. | +2-+189 | +24 | .. | −3-+69 | +15 | .. | +2-+56 |
| % of Excreted Ca in Urine | 11 | .. | 5-23 | 1.6 | .. | 0.01-4.9 | 0.9 | .. | 0.6-1.7 | 1.3 | .. | 0.4-2.3 |

form of coffee or water.

However the rats living upon fresh milk as a sole source of nutrients excreted in the urine an average of 11 mg. of calcium daily. This was also 11 per cent of the calcium excreted. Thus the kidneys of rats consuming large volumes of milk were passing about three times as much calcium as those of rats drinking a large volume of sucrose solution. This amounted to more than five times as much calcium passing through the urine as it did for rats drinking moderate levels of coffee or water. The latter rats passed the same amounts of calcium through the urine so coffee had no effect upon calcium excretion.

Long continued use of large volumes of milk might be expected to have some influence upon the calcification of the kidneys although this could not have been a marked factor in chronic disease or the milk fed rats might have died prematurely.

The data of table 8 indicate that the rats fed the milk diet only excreted about half as much dry matter as those fed the solid food. This difference in passage of materials through the intestinal tract seems to have had no marked effect upon the span of life since no differences were found among the different groups.

### Density and Composition of Bone in Relation to Age, Sex, and Diet

In order to study the composition of a typical bone the humeri were dissected from rats at the time of death. After cleaning these were extracted with ether to remove fat. They were then dipped in an alcoholic solution of zein to seal the pores. After drying they were weighed in air and then suspended in water in order to determine density and volume. They were then ashed in the muffle in order to determine ash and calcium content.

Since it is well recognized that the calcium per cent of ash is quite constant throughout the life of animals the calcium values per unit volume were calculated. These afford a better reflection of age changes since it is known that the volume of bone changes little with age but the bone does lose its ash content and forms a hollow tube as age advances.

In table 9 the data are summarized in relation to diet, sex, density of bone, and calcium per unit volume. These results indicate that the female sex, irrespective of age at death, has denser bones and more calcium per unit volume of bone. Furthermore those fed milk throughout life had denser bones and more calcium per unit volume at the time of death in spite of the lower level of calcium ingested each day by those on the milk diet. This favorable effect of the milk was more marked for males than for females.

Table 9. Density and Calcium per Unit Volume of the Humerus in Relation to Sex and Diet

| Diet | Male | | Female | |
|---|---|---|---|---|
| | Density | Ca mg./ml. | Density | Ca mg./ml. |
| Milk | 1.343 | 309 | 1.385 | 324 |
| Sucrose | 1.286 | 298 | 1.358 | 314 |
| Water | 1.254 | 291 | 1.347 | 312 |
| Coffee | 1.290 | 298 | 1.368 | 313 |

The data for density, volume, and calcium content in relation to age at death have been summarized (table 10 and 11). These indicate that the sex differences start early and persist until the end of life. These rats were never bred so the data might be quite different for rats undergoing periods of gestation and lactation. All evidence indicates that the quality of the bone of the female is superior.

The volume of the bones indicates the well established superior size of the adult male rat.

Under the conditions of this study the deterioration of bones in the course of aging was only slight in both sexes. This contrasts very much with earlier findings in retarded growth studies in which rats survived up to an age of 1400 days. Among these survivors the bones were very light and thin. At that time techniques had not been developed for measuring density and volume.

These contrasts between results when the span of life is extended beyond what seems normal may lend additional support to the

TABLE 10. CALCIUM PER UNIT WEIGHT AND PER UNIT VOLUME OF BONE IN RELATION TO AGE AT DEATH AND SEX.

| Age (Days) | Number Rats Used | Sex | mg./gm. | | mg./ml. | |
|---|---|---|---|---|---|---|
| | | | Mean | P. E. | Mean | P. E. |
| To 500 | 7 | F | 247 | 11 | 348 | 23 |
| To 500 | 14 | M | 237 | 4 | 309 | 12 |
| 500-600 | 13 | F | 232 | 8 | 311 | 17 |
| 500-600 | 11 | M | 226 | 8 | 293 | 19 |
| 600-700 | 15 | F | 228 | 12 | 304 | 22 |
| 600-700 | 19 | M | 229 | 6 | 296 | 16 |
| 700-800 | 21 | F | 231 | 6 | 316 | 14 |
| 700-800 | 14 | M | 233 | 8 | 294 | 14 |
| 800-900 | 10 | F | 228 | 7 | 309 | 16 |
| Over 900 | 9 | F | 232 | 4 | 320 | 8 |

viewpoint that the so called "normal" span for the rat really represents premature death from infected lungs and kidneys. If this were true an age of 700 to 900 days would only represent middle life and one would expect little deterioration in bones.

### DECAY OF TEETH IN RELATION TO FLUID CONSUMED

Since the data upon the teeth of rats used in this study will be published elsewhere by C. A. H. Smith only a brief summary in table 12 will be included in this report. Since most of the decay found in the teeth of old rats at the time of death occurs in the lower molars, only these teeth have been included in the data of the table.

TABLE 12. DECAYED LOWER MOLARS.

| Fluid | Number Rats Used | Decay per Rat | Free from Decay (Per Cent) |
|---|---|---|---|
| Sugar Solution | 38 | 2.6 | 40 |
| Coffee | 34 | 3.8 | 18 |
| Water | 38 | 2.4 | 13 |
| Milk | 34 | 0 | 100 |

This table indicates that no decay was found in the teeth of the milk fed rats. More than half of the entire number used in the study was examined by Smith. It is not known whether this is due to some property of milk in protecting teeth or whether the diet being entirely liquid prevented injury from abrasion. This would seem to indicate that the cleansing action of hard foods is not needed by the rat.

No essential differences were found among rats in the other 3 groups except that those without any decay were more frequent in the case of those drinking the sucrose solution than in the case of those drinking water or coffee. Since the percentage of decayed teeth was about the same in these 3 groups, the number of decayed teeth must have been

TABLE 11. DENSITY AND VOLUME OF HUMERI IN RELATION TO SEX AND AGE AT DEATH.

| Age (Days) | Number Rats Used | Sex | Density | | | Volume (ml.) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Mean | Range | P. E. | Mean | Range | P. E. |
| To 500 | 7 | F | 1.407 | 1.299-1.490 | 0.04 | 0.192 | 0.169-0.216 | 0.011 |
| To 500 | 14 | M | 1.308 | 1.172-1.414 | 0.05 | 0.258 | 0.233-0.295 | 0.014 |
| 500-600 | 13 | F | 1.340 | 1.177-1.449 | 0.05 | 0.210 | 0.176-0.282 | 0.018 |
| 500-600 | 11 | M | 1.294 | 1.166-1.403 | 0.05 | 0.276 | 0.232-0.337 | 0.020 |
| 600-700 | 15 | F | 1.343 | 1.225-1.500 | 0.06 | 0.210 | 0.176-0.265 | 0.015 |
| 600-700 | 19 | M | 1.294 | 1.143-1.401 | 0.06 | 0.277 | 0.215-0.310 | 0.018 |
| 700-800 | 21 | F | 1.372 | 1.296-1.498 | 0.04 | 0.211 | 0.183-0.237 | 0.008 |
| 700-800 | 14 | M | 1.265 | 1.152-1.348 | 0.04 | 0.297 | 0.259-0.331 | 0.013 |
| 800-900 | 10 | F | 1.356 | 1.224-1.508 | 0.05 | 0.213 | 0.198-0.229 | 0.008 |
| Over 900 | 9 | F | 1.378 | 1.292-1.456 | 0.04 | 0.213 | 0.188-0.229 | 0.012 |

higher in those drinking the sugar solution if the individuals were subject to decay. This would seem to accord with human experience in which some individuals are very subject to decayed teeth and may indicate that sucrose solutions accentuate such a condition.

### Calcification of Soft Tissues

Since details of pathology will be reported separately by J. A. Saxton, consideration in this report will only be given to the findings in the X-ray photographs made of the soft tissues shortly after death.

In table 13 are assembled data upon the calcification observed in the kidneys of animals from the 4 groups. In spite of more calcification in the kidneys of the female rats they outlive the males. The males fed the diet of milk had a higher incidence than those in any other group.

Table 13. Fluid Consumed and Kidney Calcification.

| Fluid Consumed | Number Kidneys Examined | Per Cent Calcified |
|---|---|---|
| Milk | | |
| Male | 44 | 68 |
| Female | 46 | 98 |
| Water | | |
| Male | 40 | 13 |
| Female | 46 | 87 |
| Sucrose | | |
| Male | 46 | 33 |
| Female | 48 | 77 |
| Coffee | | |
| Male | 40 | 23 |
| Female | 46 | 93 |

As rats age the incidence of marked calcification increases progressively (table 14) until it attains a value of 97 per cent after animals reach an age of 800 days. The incidence of calcification was about equal when data for the pelvis are compared with those for the medulla.

In the case of both the testes and heart the calcification increases as the rats grow older although more than half the animals remain free as far as this technique affords evidence (table 15).

Table 14. Kidney Calcification in Relation to Age.

| Age Range (Days) | Number Examined | Percentage Calcified |
|---|---|---|
| 159-399 | 40 | 38 |
| 400-499 | 48 | 56 |
| 500-599 | 102 | 59 |
| 600-699 | 68 | 62 |
| 700-799 | 60 | 72 |
| 800-951 | 38 | 97 |

Table 15. Calcification of the Heart and Testes.

| Age Range (Days) | Testes | | Heart | |
|---|---|---|---|---|
| | Number Examined | Percentage Calcified | Number Examined | Percentage Calcified |
| 159-399 | 24 | 12 | 20 | 10 |
| 400-499 | 26 | 31 | 24 | 8 |
| 500-599 | 60 | 33 | 51 | 20 |
| 600-699 | 36 | 45 | 34 | 23 |
| 700-799 | 22 | 36 | 30 | 33 |
| 800-951 | 2 | 0 | 20 | 30 |

### Summary

In order to determine the effect upon the life span 4 groups of rats were started upon different regimes shortly after weaning. One group was fed upon pasteurized cow's milk supplemented with traces of iodine, iron, copper, manganese, and cod liver oil. A second group was induced to ingest much fluid by allowing only 10 per cent sucrose solution to drink. A third group was given only coffee, and a fourth group only water to drink. The last 3 groups were fed an adequate mixed stock diet. In the case of the last 2, sugar was added to the dry feed to compensate for that consumed in solution by the second group.

The growth for all groups was very similar.

Likewise there were no differences in the total span of life indicating that liquid milk was an adequate diet for the whole span of life. No decay was found in the teeth of any animal maintained for the whole span of life upon the milk diet while animals in all other groups averaged more than two decayed molars per rat.

Significant positive correlations between the maximum body weight attained and the total span of life were found for both sexes. Similar correlations were found between the volume of a typical bone, the humerus, and the span of life. These indicate that animals that attain larger body size tend to have longer spans of life.

Rats given the milk or sucrose solutions consumed about three times as much fluid as those given coffee or water. In all groups the females drank more fluid per unit of body weight than the males. When milk served as the sole item of diet this higher liquid consumption by the females indicated a higher daily consumption of calories. Thus the longer span of life of the female rat cannot be accounted for by lower calory consumption.

At the time of death in order to study the density of bones and the calcium content, the humerus was dissected from each arm. Although the milk diet allowed the lowest daily ingestion of calcium, the bones were the most dense and contained the most calcium per unit volume at the time of death.

The paths of excretion in typical rats from each group were studied in three successive chemical balance trials. A much higher percentage of the excreted calcium was found in the urine of the rats fed milk than in the other groups. The higher liquid ingestion of the group fed sucrose solution produced a moderate increase in the excretion of calcium through the urine.

Studies of the soft tissues at the time of death by means of X-ray photographs indicated progressive calcification of the kidneys, testes, and heart with the advance of age. More calcification of the kidneys was found in rats fed the milk diet than in other groups.

Coffee fed throughout life exercised no unfavorable effect as indicated by disease or premature death. Neither diarrhea nor constipation resulted from a continuous milk diet. Coffee had little diuretic effect.

Throughout life milk tended to keep rats at the lowest level of body weight while sucrose solution kept them at the highest. This must have been a difference in body fatness since typical bones at the end of life were similar in size for all groups indicating the size of the mature skeleton must have been similar in all major groups.

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# Histologic Changes in the Aging Cochlea

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That hearing for high tones diminishes with each decade of life is now a well recognized fact and is to be regarded as a manifestation of the aging process. The degree and incidence of this hearing loss is somewhat greater in males than in females. Other factors such as the inability on the part of many aged individuals to understand rapid speech, the slowing of mental processes and the ever increasing confusion of noisy places add further to the discomfort of the impairment.

It is of interest that Murray (6) in his attempt to assess physiologic age has included hearing acuity as one of the five criteria. The results of extensive hearing surveys in this and other countries leave no doubt as to the correlation that exists between impaired hearing and old age. Histologic evidence, however, is by no means as convincing. This does not mean that the literature is lacking in descriptions of pathologic changes in the cochlea believed to be associated with aging. On the contrary there are many reports but they cannot be seriously considered because most of them are artefacts of fixation or postmortem autolysis.

The purpose of the present studies is to bring up-to-date the problem of histologic changes in the cochlea as attributed to aging and evaluate these in terms of other factors for which the pathology may be similar.

One might expect to find in an organ such as the ear which is under almost continuous stimulation a change in the various parts of the conduction apparatus of the middle ear as well as for the inner ear. In the literature are actually to be found records of such observations. A few of these are thinning and loss of rigidity of the tympanic membrane, wearing of the joints between the small bones of the middle ear, and atrophy of the fibers of the tensor tympani and stapedius muscles. It is conceivable that sufficient changes in the conduction apparatus of an ear would impair hearing to some extent.

The abundance of the elastic fibers in the capsules and ligaments of the joints of the ossicular chain have been demonstrated by Davies (1), who attributed their function to that of keeping the chain in alignment and in a more rigid state. There is no satisfactory evidence that age effects the elastic fibers in the middle ear in such a way as to alter their function. The joints between the ossicles contain a fibrocartilaginous pad, which is thought by some to undergo degenerative changes, and deposits of calcium occur in older people.

Figure 1 illustrates the appearance of the joint between malleus and incus in an aged individual with severe loss for high tones.

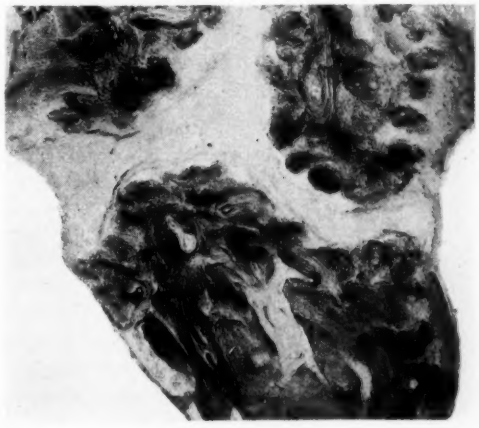

Fig. 1. Photomicrograph of the malleo-incudal joint of an aged woman who suffered from severe nerve deafness. The joint shows no abnormalities. 35 X.

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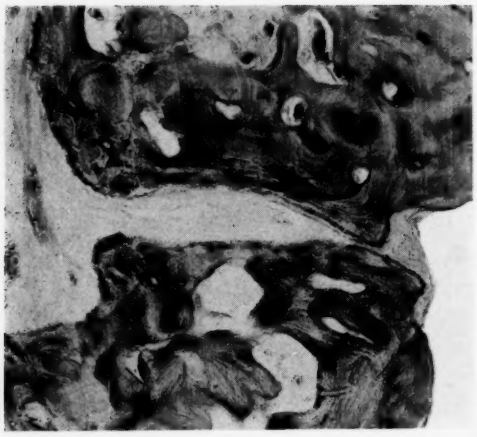

FIG. 2. Photomicrograph of the malleo-incudal joint of an aged man who suffered from nerve deafness. There is deterioration of the fibro-cartilaginous pad, areas of degeneration of the articular cartilages, and in one place close apposition of the joint surface. 35 X.

The joint shows no abnormalities. Figure 2 illustrates a similar joint from another specimen with moderate hearing impairment for high tones. There is a degeneration of the fibrocartilaginous pad and at one point the two ossicles are in close apposition. A more consistent finding with age for the structures of the middle cavity is that of atrophy of some of the fibers of the intra-aural muscles. Just how much atrophy can occur before function of the muscles is impaired is not known. Their chief function is regarded as being protective for the inner ear against loud low tones.

## THE COCHLEA

Guild (4) has shown that the organ of Corti, peripheral nerve fibers, and spiral ganglion cells do undergo degenerative and atrophic changes in instances for which severe loss for high tones occurs in the aged. Mild and less severe impairments were without histologic evidence in his series. It is the latter group of older individuals whose hearing is probably more typical of the impairment we associate with aging. In addition to these changes in the end organ and nerve fibers a varied assortment of different findings have been reported in older literature.

Since they cannot be consistently found for all preparations and many are artefacts only a few will be mentioned. Figure 3 illustrates

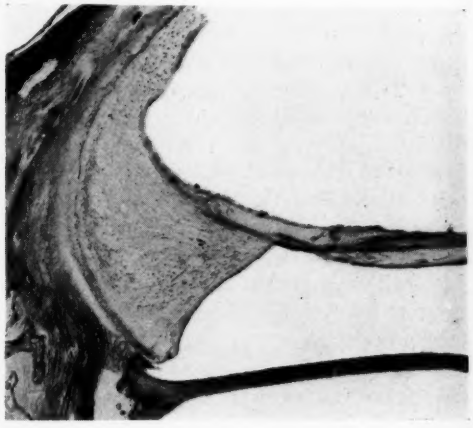

FIG. 3. Section through the lower basal turn of the cochlea of an aged man who suffered from severe nerve deafness. The cochlear duct is collapsed. There is degeneration of the organ of Corti. The basement membrane from the internal spiral lamina to the spiral ligament appears to be calcified. 45 X.

a phenomenon described by Mayer (5) as calcification of the basilar membrane. This change was apparent in the lower part of the basal turn of the right cochlea of an 83 year old man. He suffered from a nerve deafness and the organ of Corti and spiral ganglion cells were lacking throughout the basal turn. Such a finding is uncommon and cannot be looked upon as being usual in occurrence. Atrophy of the stria vascularis has likewise been found, and von Fieandt and Saxen (3) reported fewer chromophobe cells in the stria vascularis. They consider these cells to be precursors of the chromophile or secretory cells. These and other findings relating to the stria vascularis await confirmation. Pigment (melanin) in the stria and adjacent areas of the scala vestibuli has attracted some speculation, and Wolff (10) found it more often in temporal bone preparations of aged individuals.

Rasmussen (8) counted the nerve fibers in cross sections of the auditory nerve and found 2200 less fibers in the cochlear division for ages 44 to 60 years than for younger age groups. The hearing of these individuals was presumably normal. As the nerve fibers leave the modiolar canal they pass through small bony canals in the fundus of the internal auditory meatus. Figure 4 illustrates the course of

FIG. 4. Section through the fundus of the internal auditory meatus of an aged man with severe nerve deafness. There is an increase in fibrous tissue and laying down of osteoid tissue at points where the nerve emerges from the cochlea. 65 X.

the fibers at this point. In this particular specimen there is a narrowing of the canals due to some osteoid and fibrous tissue deposition. Such a finding is not uncommon in older people and it may be one contributing factor although the reaction about the more peripheral fibers of the basal turn is no more extensive than for the central areas of the fundus. Psammoma bodies occur frequently in the internal auditory meatus of aged individuals as well as in the region of the gasserian ganglion. Figure 5 illustrates one such body and a developing psammoma in a branch of the VIIIth nerve. These bodies at times are fairly numerous and their occurrence has been thought by some to be responsible for nerve deafness and tinnitus.

FIG. 5. Same specimen as Fig. 4 showing a developing psammoma body and a mature concretion in the vicinity of the internal auditory meatus. 60 X.

## DISCUSSION

Many hypotheses have been advanced in explanation of the loss of hearing for high tones with advancing age. One of the most common theories is that the cochlea is developed rather late phylogenetically and hence is more susceptible to factors causing deterioration, of which old age may be one. Another hypothesis is that of an inherited tendency for nerve type deafness. All old people do not show the same degree of hearing impairment. Hormonal factors have been said to be the contributing factors, but again sufficient evidence is lacking. Vascular pathology does cause hearing impairment and is to be correlated with advancing age to some extent but it is doubtful that it can wholly explain the prevalence of hearing loss of the type commonly associated with aging. Nutritional factors and vitamins lacking in the diets have been considered repeatedly but without avail. Hearing may improve with administration of vitamins and regulation of diet but the effect is probably on the body as a whole and the patient feels better.

Before any hypothesis can be accepted, a better understanding of the factors responsible for a similar hearing loss in young and middle-aged individuals is necessary. In recent years

it has been shown that the offspring of a mother who has had German measles during the first trimester of pregnancy may suffer from nerve deafness. Another important contribution to the causes of deafness is incompatability of the Rh factors with the production of erythroblastosis fetalis in the infant. The study of psychogenic deafness offers further possibilities. There is no doubt that mental processes become slowed with age. It is probable that a whole variety of factors are the cause of the high tone loss with age. Eventually it may be possible to ascertain which are the results of aging and which are to be attributed to some coincidental factors.

Not to be overlooked among important contributing factors to deafness is that of acoustic trauma. The histologic evidence in the cochlea of animals exposed to loud intense tones for short periods of time shows degeneration of the organ of Corti, atrophy of spiral ganglion cells, and loss of peripheral nerve fibers. Perlman (7) has stated that aging individuals are more susceptible to acoustic trauma and their recuperative powers less marked than younger individuals.

The pattern of the blood vessels in the modiolus of the cochlea and the structure of the walls and terminations of the finer arterioles and capillary beds has recently been studied in our laboratories by Smith (9). The investigations have contributed to a better understanding of the vascular supply particularly from the standpoint of the finer details. At present, interest in the vascularity of the inner ear has been revived and many clinical manifestations of deafness, vertigo, and tinnitus are now presumed by some to be on the basis of impaired circulation. Smith, in observing the flow of blood through the cochlea in anesthetized animals, has observed areas of hyperemia in the spiral ligament. These are probably within the capillary network of the stria vascularis and since they are transitory may represent some mechanism whereby secretion of endolymph is controlled.

Fernandez (2) in the laboratories of the Department of Otolaryngology and The Central Institute for the Deaf has further investigated the innervation of the cochlea. It is of interest that fibers in the basal turns are more numerous than those of the apical turns; that some fibers may traverse more than a turn from a spiral ganglion cell located in a lower area; and, in degeneration of the fibers, the intraganglionic spiral bundle remains intact. The latter represents an efferent system with endings chiefly on the inner hair cells. Its cells of origin are located in the superior olivary complex of the opposite side.

It is only through a better understanding of the physiologic and histologic details of the cochlea that aging effects can be determined. There is a possibility that high tone loss is established in youth or middle age and becomes accentuated with the advance in years. In the laboratory such a problem could be studied on a large series of animals of different ages. Their hearing could be evaluated by the newer physiologic methods and correlated with histologic findings.

## Summary

1. Histologic evidence for loss of hearing of high tones with advancing age is not definite.

2. A thorough understanding of factors capable of producing nerve deafness, at different ages, is necessary before old age can be said to be a single factor.

3. A controlled series of experimental animals of different ages for which hearing can be evaluated by physiologic and histologic methods offers an approach to the problem.

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# A Comparison of Age Changes in Salivary Glands of Man and of the Rat

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A wide field of investigation lies open in comparative studies of age changes in various organs in different animal species. The opportunity has been afforded to make such a comparison between the salivary glands of Wistar Institute rats and of man.

The greater part of the rat material has been surveyed and described in two previous papers (3, 4).

The human salivary glands have been shown to exhibit a decrease in functional activity in old age. The basal (fasting) saliva in subjects 60 to 96 years old contains only one-third to two-thirds as much ptyalin as that of individuals 12 to 60 years of age (14). In addition to this decrease in concentration of the enzyme, it seems probable that total secretion is considerably reduced in old persons.

The histologic descriptions of the human salivary glands in senility are not numerous and emphasis in the separate studies frequently is on different features not readily compared. Two papers have dealt primarily with the subject of the fat content. Schramm (18) studied the submandibular glands of 26 subjects and the sublingual glands of 37 subjects. Even before the seventh decade he found some fat present in many of the glands. After the age of 60, however, all of the glands contained abundant fat. Larger amounts were seen in the sublingual than in the submaxillary glands. Schramm does not believe that the fat deposits seen would have any general influence on secretory activity of the gland.

Yamaguchi (23) observed an increase in fat content of the salivary glands in various pathologic conditions and in senility. He found the intensity of fatty infiltration in general to be greatest in the submandibular gland, next in the parotid, and least in the sublingual gland. His studies were made on frozen sections prepared by various fat stains. The fat in the gland-cells gave a positive Smith reaction for neutral lipoids. Although some of his subjects were over 70 years of age, he believed that the fatty infiltration of the gland cells, on the basis of histologic observations at least, would seem to have no inimical effect on the secretory activity of the cells.

Such conclusions seemed to be in marked contrast to my findings in the rat. Here, in the parotid gland, the process of fatty change seems to be one of clear-cut fatty degeneration with destruction of cells, alveoli, and even whole lobules of secreting tissue. The histologic picture would indicate a very severe loss of function in this gland in old age in the rat. The extension of my studies to the submandibular gland, however, showed that the latter organ, in the rat at least, exhibits practically no fatty change with age. A reexamination of these two glands in the human subject and a more direct comparison with the rat seemed, therefore, to be highly desirable. It was considered important to determine not only the approximate amount of fat deposited in human glands but also whether such deposition involves a direct destruction of secreting parenchyma, as it does in the rat parotid.

A second important feature described as occurring in the salivary glands of senile individuals is the presence of peculiar large cells, the oncocytes. These cells were first described in the human glands by Hamperl (10), and later in the rat (Andrew, 3, 4). In my material they possessed a distinctive cytoplasm of a foamy, reticulated type.

Hamperl expressed the belief that the honeycombing of the cytoplasm is a transitional stage in the development of the fully differentiated granular cytoplasm.

The nuclei are often pycnotic, but sometimes vesicular with a very large nucleolus. The nuclei of either type may be found in process of amitotic division.

In the rat, both in the parotid and submandi-

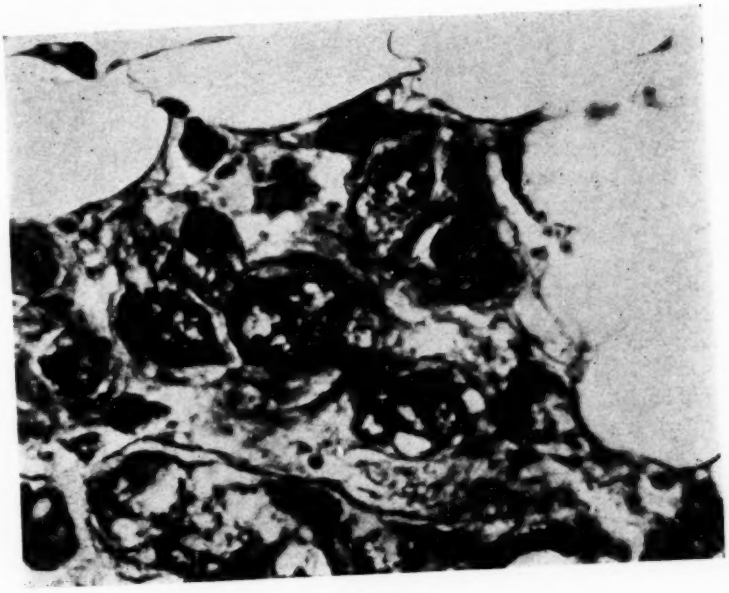


PLATE 1

FIG. 1. Aberrant cell (oncocyte) in the submandibular gland in a 72 year old man. Note the three adherent nuclear vesicles. X 1200.

FIG. 2. Aberrant cell (oncocyte) in the parotid gland of a 66 year old man. X 1200.

bular glands, the oncocytes occur in such large numbers in senility that study of only one or a few low-power fields makes it possible to tell whether the section is from a young or old animal. It was thought desirable to investigate whether or not such a distinction could be made this readily in man.

A third feature of the senile salivary glands in the rat is the infiltration of the interlobular and interalveolar connective tissue by lymphocytes and mast cells and the penetration of such cells into the epithelium of the ducts. This infitration was almost constantly present in sections of old glands and did not seem to be a part of an inflammatory process in any usua! sense of the term.

These features then, (a) fatty infiltration and degeneration, (b) the presence of aberrant epithelial cells or oncocytes, and (c) the occurrence of infiltration by lymphocytes and other wandering cells, were to be looked for in the human material. In addition, of course, any changes peculiar to the human glands were to be described.

## Materials and Methods

The human salivary glands here described are surgical specimens obtained from the Ellis Fischel State Cancer Hospital at Columbia, Missouri. The surgery involved was the radical neck operation for removal of carcinoma in or near the oral cavity.

While some objections might be raised in regard to drawing conclusions from the study of the salivary glands of such patients, even greater ones could be raised in relation to most autopsy material where a widespread disseminated group of changes may be expected. In regard to these specimens, according to the opinion of L. V. Ackerman the only really serious objection would be in cases in which previous irradiation had been given and the salivary glands were included in the field. In choosing the paraffin blocks we therefore avoided such specimens.

The tissue was sectioned in our laboratory at 6 $\mu$ and several sections mounted on each of 10 slides. Four slides were stained with Harris' hematoxylin and eosin, 2 with Heidenhain's iron hematoxylin and eosin, 2 with Mallory's triple connective tissue stain, and 2 with hematoxylin-eosin-azure, particularly for lymphocytic and other leucocytic elements.

Thirty-one glands are represented in this study, 16 parotid and 15 submandibular. Unfortunately, it was not possible in all cases to have both glands from the same individual. There are 10 subjects, however, for which both glands have been studied, leaving 11 for which only one or the other gland is represented (table 1).

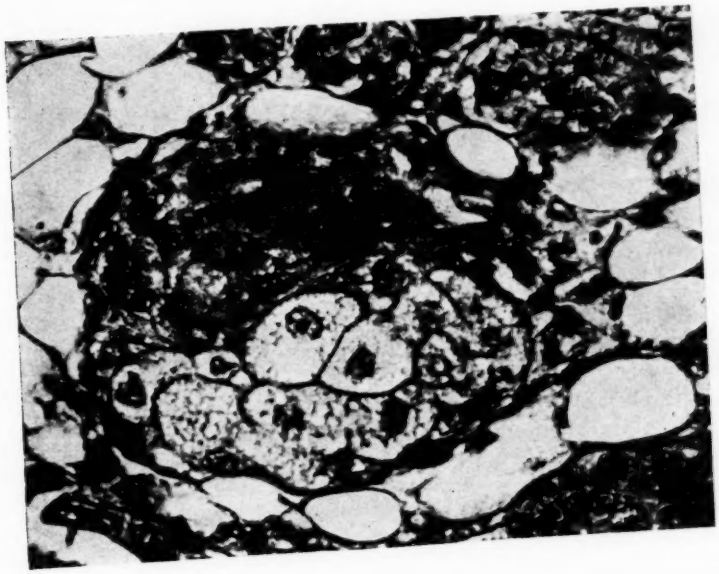
Since 10 or more large sections of each gland were available for study, it was believed that a fair sampling for the characteristics of the individual organs was obtained, although ideally it would have been better to have the entire gland or a number of pieces for study. It is true, however, that the features seen in small areas of a section generally seemed to obtain throughout the specimen or the greater part of it.

All sections were surveyed under the low-power magnification (X 100), further studied with high-power magnification (X 440), and more detailed study carried out with oil-immersion (X 970).

## Observations

Initial study of the sections showed that a very great amount of fat is present in the majority of the parotid glands, more so than in the submandibular glands, but that all of the latter also have varying amounts of fat. It seemed worth while to set up some at least partly objective criterion for the amount of fat present and this has been done by indicating the degrees as + (less than 10 per cent of the section occupied by fat) ++ (10 to 25 per cent), +++ (25 to 50 per cent), and ++++ (50 per cent or more). With the amount of difference noted between the two types of glands (table 1) this grading system has proved very useful.

It will be noted that 4 of the parotid glands have 50 per cent or more of parenchyma replaced by fat and 7 have 25 to 50 per cent



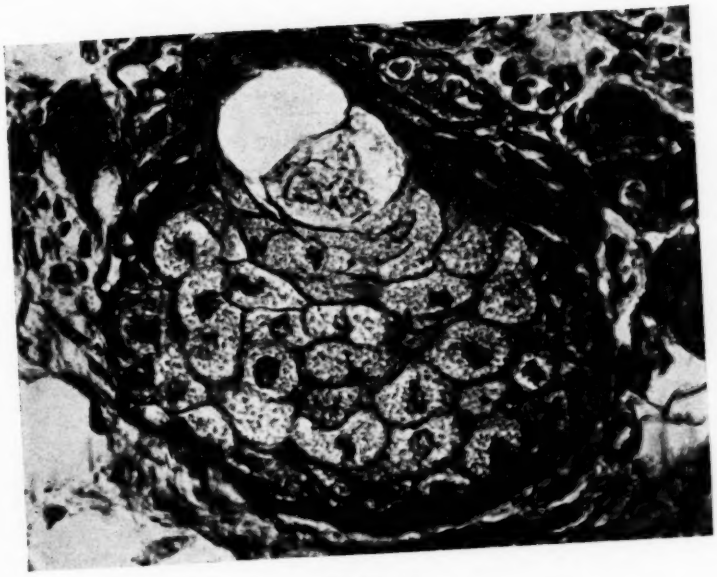


PLATE 2

FIG. 3. Group of cells resembling oncocytes in the parotid gland of a 66 year old man. Tracing of serial sections reveals these to be part of a sebaceous gland formed by metaplasia of a salivary duct. X 1000.

FIG. 4. Well developed sebaceous gland in the submandibular gland of the same subject represented in fig. 3. Note evidence of holocrine secretion at upper end of gland. X 1000.

TABLE 1.

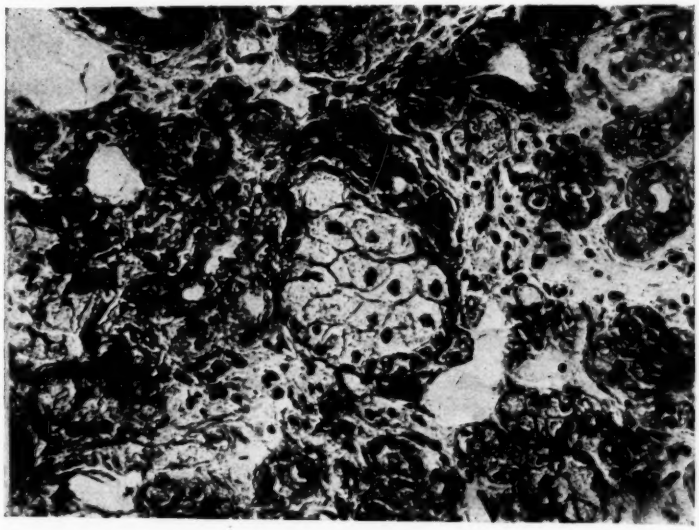
| Pathology Number | Age in Years and Sex | Fatty Degeneration | | Lymphoid Tissue | | Fibrosis | | Aberrant Epithelial Cells | |
|---|---|---|---|---|---|---|---|---|---|
| | | Parotid | Submandibular | Parotid | Submandibular | Parotid | Submandibular | Parotid | Submandibular |
| 472110 | 54 M | ++++ | ++ | 0 | + | 0 | 0 | 0 | 0 |
| 47159 | 60 M | ++++ | + | 0 | + | 0 | + | 0 | 0 |
| 471902 | 65 M | | ++ | | + | | + | | 0 |
| 471123 | 65 M | + | + | 0 | + | 0 | 0 | 0 | 0 |
| 472205 | 66 M | ++++ | ++ | + | + | 0 | + | + | + |
| 46827 | 68 M | +++ | | + | | 0 | | 0 | |
| 4821 | 69 M | +++ | | + | | 0 | | 0 | |
| 462103 | 69 M | ++ | ++ | 0 | 0 | 0 | 0 | 0 | 0 |
| 461509 | 69 F | +++ | | 0 | | 0 | | 0 | |
| 48420 | 71 M | +++ | | 0 | | 0 | | 0 | |
| 45643 | 71 M | ++ | | + | | 0 | | 0 | |
| 48604 | 72 M | +++ | ++ | 0 | + | 0 | 0 | 0 | + |
| 481648 | 72 M | +++ | ++ | 0 | + | 0 | 0 | 0 | + |
| 47549 | 72 M | | ++ | | + | | 0 | | + |
| 481640 | 74 M | +++ | ++ | 0 | + | 0 | 0 | 0 | |
| 471973 | 74 M | | ++ | | + | | + | | + |
| 472215 | 75 M | ++++ | + | + | 0 | 0 | + | 0 | 0 |
| 481271 | 76 M | | + | | + | | + | | 0 |
| 451019 | 76 M | | ++ | | + | | 0 | | + |
| 471863 | 77 M | ++ | ++ | + | + | 0 | 0 | 0 | 0 |
| 45468 | 83 M | | + | | + | | 0 | | 0 |

replacement, the remaining 4 having lesser degrees. None of the submandibular glands has over 25 per cent replacement, although 11 are in the 10 to 25 per cent group and the remaining 5 show less than 10 per cent replacement.

The question of whether the replacement means an actual loss of secreting parenchyma through fatty degeneration of the cells is a very important one. I found few clear-cut instances in which the histologic picture would allow it to be said definitely that this is the case. In some areas, however, the alveolar cells seem to be in process of degeneration (fig. 9) with the appearance of individual fat spaces or "cells" replacing individual alveoli.

To investigate the mechanism of fatty change further, a number of sections of parotid glands of senile rats were re-examined. A very significant conclusion may be drawn from such sections, namely, that the fat locules result from a fusion of increasingly larger droplets. The fat-droplets within individual gland cells fuse to form larger ones and these eventually fuse with those of neighboring cells. The fat locule or "cell" seems to be truly of multicellular origin in this process (figs. 11 and 12). For the rat, the histologic picture seems clear-cut, and I believe, by deduction and by observations of some similar appearances, that the same type of process occurs in the human parotid gland.

For the submandibular gland, since fatty change is almost nonexistent in the senile rat, it has not been possible to obtain as clear a picture. The histologic evidence in the human gland could be taken as favoring a simple fatty infiltration more than a truly degenerative change. In the human glands, however, it might be less likely that one would find the active process in particular sections since it might occur in a relatively short space of time and the static picture then be maintained longer than in the short-lived laboratory



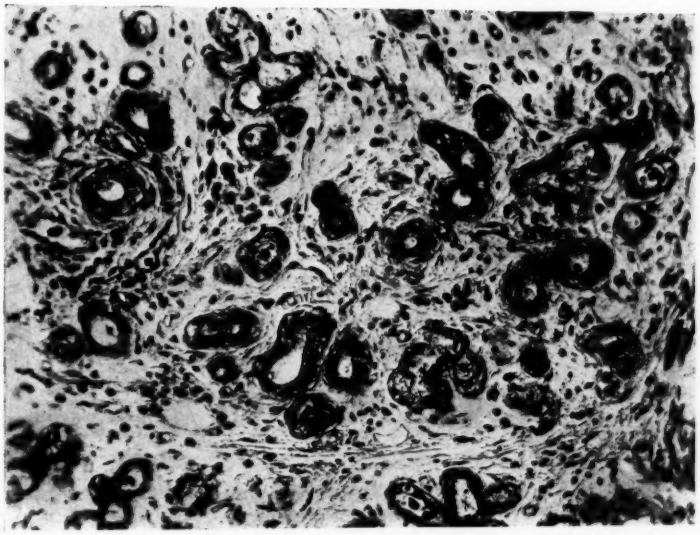


PLATE 3

FIG. 5. Sebaceous gland in submandibular gland of a 66 year old man. Little fatty degeneration is seen but a slight fibrosis is present. X 300.

FIG. 6. Marked fibrosis in the submandibular gland of a 60 year old man. Fibrotic change with age usually is not extensive and seems to occur in individual lobules rather than throughout the gland. Mallory's aniline blue connective tissue stain. X 300.

animals.

It seems a matter of fundamental importance to pathology to recognize the type of fatty change seen so clearly in the parotid gland of the senile rat and less so in man. Other instances of this hitherto undescribed type of replacement of parenchymatous glandular elements by fatty tissue should be sought for.

The second feature to which particular attention was paid is the presence or absence of aberrant cells in the salivary glands, either in the alveoli or in the ducts. In table 1 it is seen that only 1 parotid gland and 6 submandibular glands show such cells. Study of the parenchyma in this series of human glands, at least, then, does not present any such striking criteria of senility as seen in the rat.

The aberrant cells present a somewhat varied picture in this human material. Nuclear peculiarities, such as the division of the nucleus into lobes or individual adherent vesicles, are the more outstanding features both in the parotid and submandibular glands (figs. 1 and 2).

It would be difficult, in fact, to characterize the cytoplasm of such cells other than to say that it varies more in appearance than does that of the normal cells. It is light and wide-meshed in some aberrant cells but deeply staining in others.

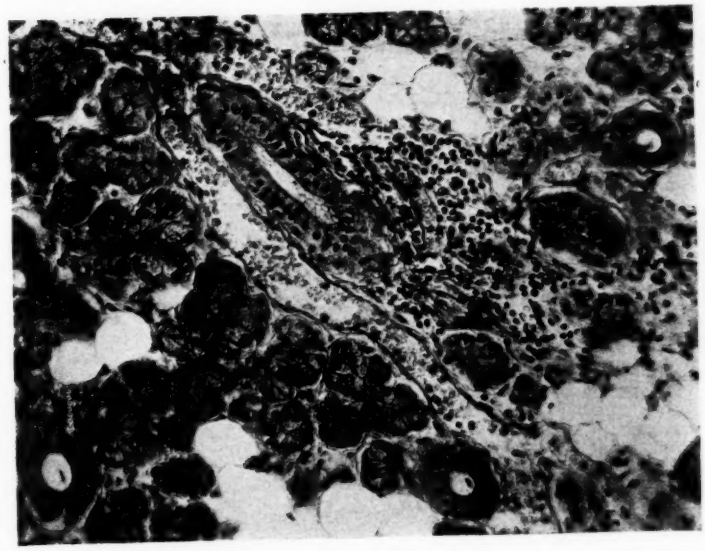
In one subject, a 66 year old male, I thought, on first examination of the parotid gland, that groups of oncocytes such as had been found in the rats were being observed. These groups or nests were made up of cells with conspicuous reticulated cytoplasm. On following serial sections of this specimen, however, it became clear that this was a different type of structure, in fact, a well-developed sebaceous gland. Other such glands were now found in considerable numbers in this parotid and also in the submandibular gland of the same individual, but in none of the other subjects. They apparently arise by a metaplasia of portions of the striated ducts. Their resemblance to oncocytes, when seen only in part, is striking (fig. 3).

The third feature to which particular attention was paid was the occurrence of infiltration of the glandular tissue by lymphocytes or the presence of accumulations of such cells in the interlobular connective tissue. Infiltration of the ducts is present almost constantly but varies in different areas of the same section. Accumulations of lymphocytes are seen in 6 of the parotid glands and in 14 of the submandibular glands (table 1). Such accumulations consist primarily of masses of small lymphocytes and often occupy almost all of the interlobular space outside of the ducts and vessels (fig. 7). In some of them reticular cells seem also to be present and even a beginning of a pale center or "germinal center" seems to be discernible.

No mast cells nor any types of wandering cells other than lymphocytes were seen in any of these specimens.

An interesting feature is seen in the lymph nodes within the glands in many of these specimens, namely, the presence of inclusions of epithelial tissue which, as far as I can tell, are isolated amid the lymphoid tissue. They seem to be in tubular and alveolar form and show a very distinct basement membrane formed of collagenous fibrils (fig. 8). Similar epithelial inclusions have been described by Carere-Comes (7) in lymph nodes of 3 out of 30 human subjects in which different groups of nodes were studied and none of which was cancerous. Andrew and Andrew have described epithelial inclusions in the deep cervical nodes of Wistar Institute rats, in which they are more common in younger animals (5).

Fibrosis is not by any means a marked feature in the senile salivary glands. None of it was found in the parotid glands but it did occur to varying degree in 6 of the 16 submandibular glands. It occurs in these glands as a phenomenon of lobular distribution, i.e., certain individual lobules are markedly affected while nearby ones may be entirely spared. The connective tissue which comes to separate the alveoli widely from one another (fig. 6) consists of fine collagenous fibrils and of many fibroblasts of a primitive "embryonal" aspect.



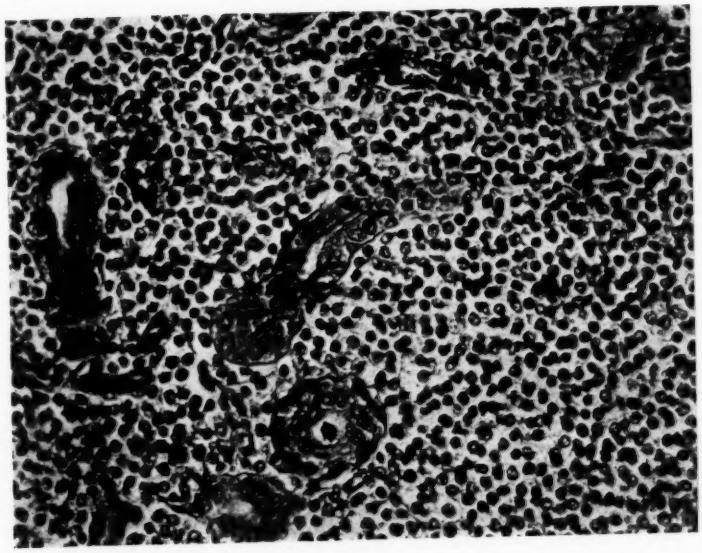


PLATE 4

FIG. 7. Accumulation of lymphocytes in interlobular tissue in submandibular gland of a 72 year old man. X 300.

FIG. 8. Epithelial "inclusions" in the substance of lymph node within the parotid gland of a 68 year old man. X 400.

## Discussion

The striking fatty change seen in the parotid gland of senile rats I have described as "fatty degeneration." In the literature of pathology the terms relating to fatty change have been interchanged in a somewhat confusing manner and more recently the term "fatty metamorphosis" has been applied to the changes occurring in the liver cells. One clear-cut instance of destruction of cells by a fatty change is seen, however, in the sensory neurons of the aged. Truex (20) and Truex and Zwemer (21) described accumulation and fusion of fat droplets leading to degeneration of many cells in sensory ganglia in old age in man, cat, and rat. In the process which I have described it has been considered important to emphasize the truly destructive nature of the phenomenon.

The concept of a multicellular origin of fat locules is apparently a new one. While it seems to me from my histologic observations to be by far the most plausible conclusion in this case, another interpretation might be made. It could be proposed that the spaces left by the degenerating alveoli are reduced by pressure of invading true adipose tissue and eventually replaced by true "fat cells." My interpretation does have the difficulty of suggesting the occurrence of a really non-cellular "adipose" tissue to which the present-day physiologic concept of fatty tissue and its metabolizing and turn-over characteristics scarcely could apply.

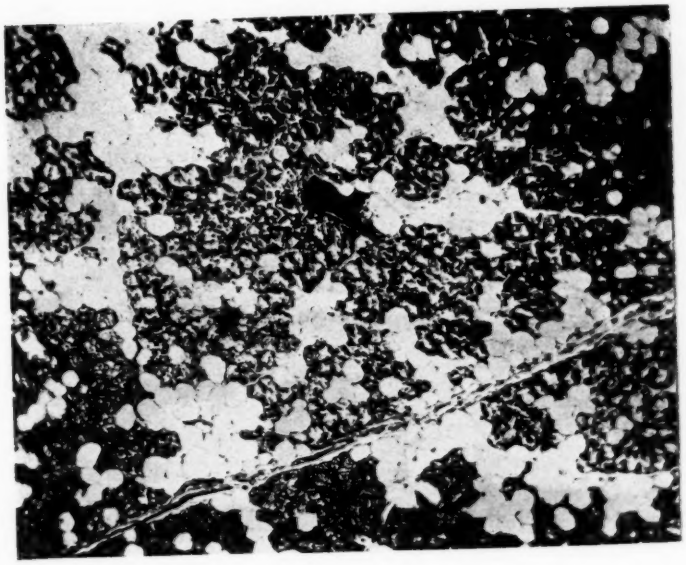
I believe that this comparative study gives evidence that the process in rat and in human parotid is a degenerative one, but for the submandibular gland the interpretation of the nature of the fatty replacement process is not possible.

The relatively small number of glands showing aberrant cells, or oncocytes, in this series was somewhat unexpected. There is but 1 of the parotid glands and 6 of the submandibular glands which show such cells. In the glands where they are present they are not as numerous as in the glands of old rats.

From the description of Hamperl (10, 11) it would have been expected that oncocytes would be much more conspicuous in the salivary glands of elderly persons. I have no adequate explanation for this difference in findings. That oncocytes do occur in old individuals and occasionally give rise to tumors and oncocytic adenomas is well substantiated. Ackerman (1) described such a tumor in a 76 year old man and listed the cases reported by earlier authors. The average age of the patients was 72 years. Stump (19) reviewed the literature of this subject and listed 10 cases of this type of tumor. The patients ranged from 53 to 83 years of age. He also described in detail 1 new case. It is his belief that no tumor should be classified as an oncocytoma unless its cells are known to take a bright eosinophilic stain. These cells also have a granular content rather than a foamy, vacuolated cytoplasm. Allegranza (2) has stated that these granules consist of "proteins, sometimes linked with lipids."

I have had an opportunity to see 3 oncocytomas, one in the laboratory of W. H. Bauer, Department of Pathology, St. Louis University School of Dentistry, and 2 in the laboratory of R. E. Johnson at the Ellis Fischel Hospital. These tumors consisted chiefly of low columnar, brightly eosinophilic, granular cells with either vesicular or darkly staining nuclei and did not bear a very close resemblance either to the aberrant cells which are so abundant in the salivary glands of senile rats nor to the aberrant cells in the human glands. They seemed to be a more specifically differentiated type of cell probably arising from the striated ducts. If such cells were present, even in small numbers, in the present human material, it would seem peculiar that they would not be more conspicuous. The granular contents of many cells in these pathologic specimens is poorly preserved but a fairly wide zone near the periphery of the specimen shows beautiful preservation of the granules in alveolar cells.

Meza-Chavez (15) in a study of parotid glands from 51 persons found that 9 of the 51 showed oncocytes or as he prefers to call them "oxyphilic granular cells." In 8 they were in both parotids; in the ninth only one



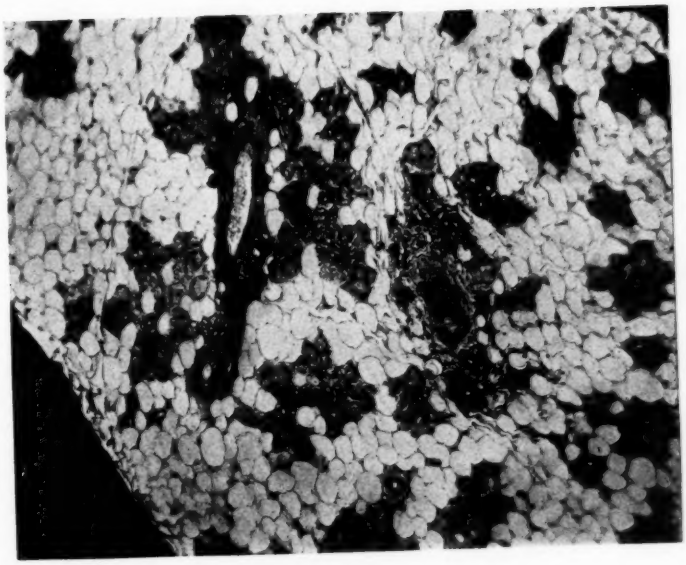


PLATE 5

FIG. 9. Extensive fatty degenerative change in parotid gland of a 68 year old man. X 100.

FIG. 10. Fatty degeneration in parotid of a 66 year old man. Ducts and small masses of interlobular tissue often are left seemingly isolated by such a change. X 250.

parotid had been obtained. They were in either the ducts or acini or in both and usually seen in several of the areas of the section studied. Some of the ducts in which such cells were found were dilated and contained oxyphilic granular material. Some showed infolding of their walls. In 4 cases "hyperplasia" of ducts was present. The description by Meza-Chavez again stresses the distinctive cytoplasm with eosinophilic granules. The aberrant cells which I have described in the rat and now for man do not follow as set a pattern as the "oxyphilic granular cells" which seem to represent one type, if not one stage, of aberration.

When I first came upon small groups of large, lightly staining cells such as those seen in fig. 3, I believed that here were the oncocytes of human salivary glands, but a closer study soon showed these to be nothing other than sebaceous glands brought about by metaplastic change in the ducts. Hartz (12) seems to have been the first to describe such structures. His case was that of a 34 year old white woman who had been operated on for a noncancerous tumor of the parotid gland. In several otherwise normal lobules of the surrounding glandular tissue sebaceous glands were found.

More recently Meza-Chavez (16) carried out an extensive search for these structures, studying 100 normal parotid glands and 133 with tumors. He found structures which could not be differentiated from sebaceous glands in 28 per cent of the normal glands and in 24.8 per cent of the glands with tumors. The occurrence of the sebaceous glands did not seem to be related to age, sex, or state of atrophy, but they did seem to be numerous and better developed in the cases where they occurred along with tumors.

It is interesting to note that sebaceous glands were found *both* in the parotid and submandibular glands in the 1 subject in the present series where they occurred. It is unfortunate that the cases reported by other authors do not permit of comparison between the different types of salivary glands.

The development of sebaceous glands in regions of the body where they are not normally found has been described by Nicholson (17) and Dougherty (8) for the cervix uteri, probably on a basis of "irritation," and by Florentin and Binder (9) for the mammary gland, as a result of injection of strong doses of folliculin.

The accumulations of lymphoid tissue seen very frequently in the submandibular glands of these old persons and somewhat less so in the parotid glands have seemed to me to represent relatively stable formations of lymphoid tissue rather than simple infiltration by transitory wandering cells. Similar accumulations were seen in the liver under various pathologic and experimental conditions (22) and in old age (6). The colonies seemed to grow in size both by the addition of new cells from the blood stream and by cell division. Kingsbury (13) has pointed out the occurrence of lymphatic tissue and its association with degenerative processes in the small glands of the mouth, larynx, and laryngopharynx in the cat. In the present human material, however, it does not seem to be clearly associated with degeneration of the glandular parenchyma.

## Summary

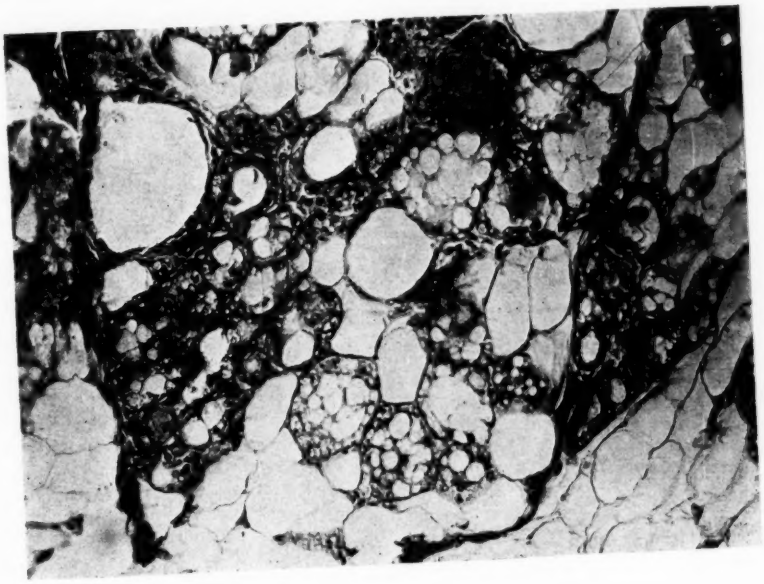
A study has been made of 31 human salivary glands, parotid and submandibular, from surgical specimens.

A very great degree of fatty replacement is seen in old age in the parotid gland and less in the submandibular gland. This relationship between the glands is similar to that seen in the rat.

For the parotid gland, both in rat and man, there is clear evidence that the fatty change is a destructive one, involving degeneration of parenchymatous elements through accumulation of fat in them.

Aberrant cells are less abundant and conspicuous in the human glands in this series than in the rat material studied earlier. When found, they show both nuclear and cytoplasmic changes but are hard to classify as a specific cell-type.

Metaplasia of the small ducts to form true sebaceous glands was seen in both parotid and submandibular glands in 1 subject. Such



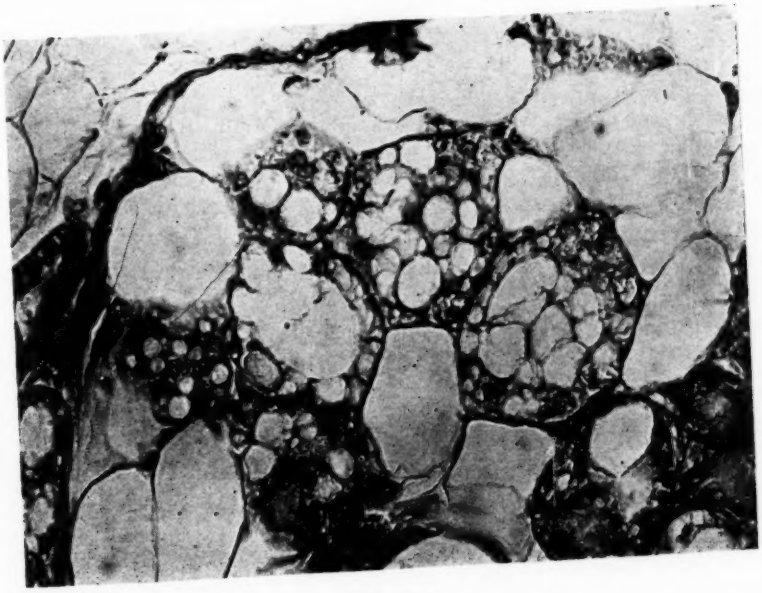


PLATE 6

FIG. 11. Parotid gland of a senile rat (900 days). Much of the secreting tissue has been destroyed by fatty degeneration of alveoli. Mallory's aniline blue connective tissue stain. X 100.

FIG. 12. Detail of an area of fatty degeneration in gland represented in fig. 11. The fat droplets are seen to appear in individual epithelial cells, to coalesce, and finally to fill all the volume of what formerly was an alveolus, also seeming to expand the framework of the spaces. Mallory's aniline blue connective tissue stain. X 400.

glands can be mistaken for groups of oncocytes.

Accumulations of lymphoid tissue are common in the salivary glands in old age in man as in the rat.

Fibrosis is not common in the aging gland of either man or rat.

This study was supported by a grant from the National Cancer Institute, as one of a series of papers concerning a comparison of cellular aberrations in senility with those occurring in oncogenesis. Grateful acknowledgment of this support is made.

I am greatly indebted to Dr. Lauren V. Ackerman, Professor of Surgical Pathology at Washington University School of Medicine, St. Louis, for his suggestion as to a source for the material used in this study and his cooperation and that of Dr. Richard E. Johnson, Pathologist at the Ellis Fischel State Cancer Hospital, Columbia, Missouri, in obtaining it.

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# Aging of Neurofibrils

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In a previous paper (14), a special change of the neurofibrillar network connected with the accumulation of lipochrome pigment (Hueck's lipofuscin, 5) in the cytoplasm of human nerve cells was described and was designated as lipochrome-neurofibrillar degeneration. In the same publication the literature dealing with this subject (4, 6, 13) was discussed in detail and emphasis given to the contentions of Marinesco (7, 8, 9, 10, 11) and Bielschowsky (1, 2, 3) that the observed network was of a plasmatic, not of a fibrillar character. The occurrence of lipochrome neurofibrillar degeneration has since been repeatedly observed by the author in nerve cells of this type in younger and older humans, both under apparently normal conditions and associated with various pathologic states. Since it has been found that the degree of lipochrome-neurofibrillar degeneration seems to progress markedly with age, this degeneration may probably be interpreted as evidence of aging of the neurofibrils.

## Material and Methods

Central nervous tissue (cerebral and cerebellar cortex, medulla oblongata, spinal cord and ganglia) and sympathetic ganglia of human subjects of various ages have been studied under normal and different pathologic conditions.

Several variations of the Cajal silver method, the Bielschowsky method, and especially the modification of the Bielschowsky method introduced by Reumont (12), were used. Cajal's alcohol-ammonia and Reumont's methods both gave very satisfactory preparations.

## Results

In the lipochrome neuro-fibrillar degeneration the accumulation of cytoplasmic lipochrome pigment produces adhesion of the neurofibrils with a simultaneous formation of an intrapigmentary fibrillar network (fig. 1). The network is intensively stained by reduced silver. This staining shows it to consist of fine trabecules connecting nodules of various forms and sizes. The presence of both trabecules and nodules in the fibrillar network is responsible for the irregular form of the meshes of the network (fig. 2). This irregularity of the interfibrillar spaces is a characteristic feature of the lesion which makes it possible to identify even when the lipochrome granules are not stained by selective methods.

Surrounding the pigmentary network is found a dense ring of agglutinated neurofibrils, the localization of which suggests that they have been displaced towards the periphery of the cytoplasm as a consequence of the increasing pigment accumulation. This ring or border of neurofibrils (figs. 3 and 4) maintains continuity with the intrapigmentary network through connections. These connecting fibers may, however, be partially or completely interrupted, probably by sudden increases in pigment accumulation. Such accumulation may likewise explain the irregular fragmentation to which the whole pigmentary network may be subjected. The histologic findings in the latter cases show irregular fragments of network with occasional thick trabecules or nodules which give the appearance of being suspended within the pigmented zone. The Nissl bodies and the Golgi apparatus seem to disappear from the zone of lipochrome-neurofibrillar degeneration, these structures apparently being displaced by the accumulation of lipofuscin.

The process may be described as following three subsequent stages: 1) an initial stage, which shows a neurofibrillar dissociation and

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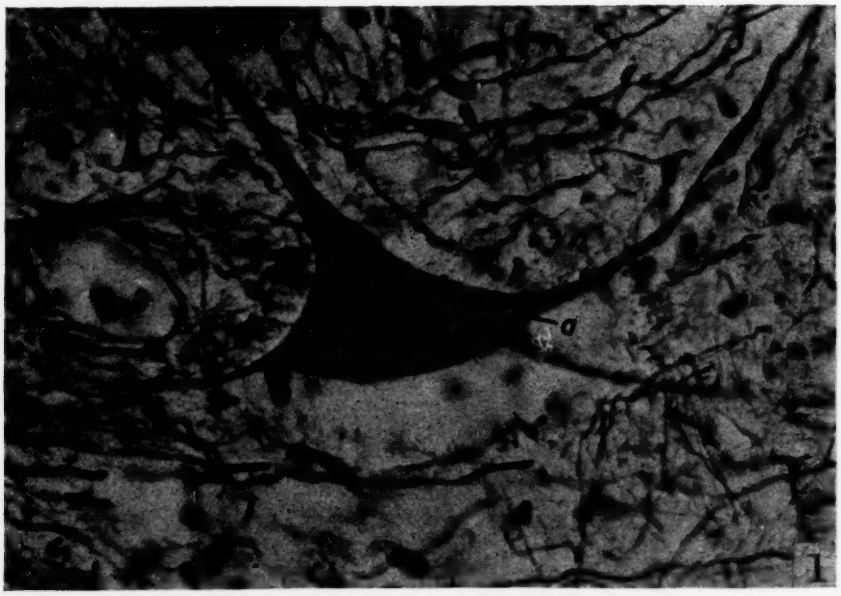


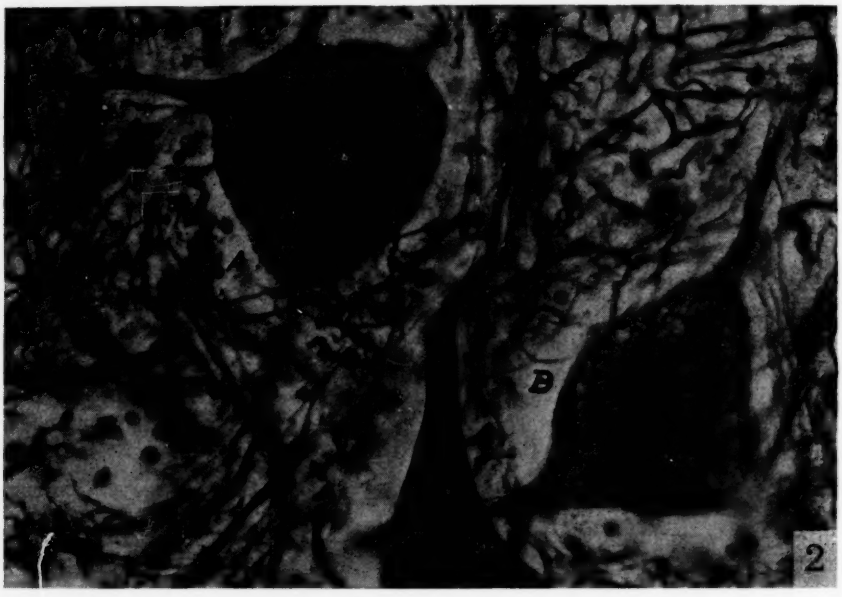


FIG. 1. Photomicrograph of a nerve cell showing the initial stage of the lipochrome neurofibrillar degeneration in a limited zone *a*. Human spinal cord, anterior horn. Reumont's method, X 600.

FIG. 2. Photomicrograph of three nerve cells, two of which, *A* and *B*, show different degrees of the progressive stage of the lipochrome neurofibrillar degeneration. Human spinal cord, anterior horn. Reumont's method, X 600.

agglutination, giving rise to the beginning of the intrapigmentary network (fig. 1 and 4-A); 2) a progressive stage, characterized by an increase of the network volume and by the appearance of the peripheral border of agglutinated neurofibrils (fig. 2, 3, and 4-B and C); 3) a regressive stage (fig. 4-D), which shows the fragmentation into irregular network pieces, leading to the final neurofibrillolysis (fig. 4-E).

## Discussion

The lipochrome neurofibrillar degeneration described is found only in connection with the deposition of lipofuscin pigment but not with melanotic pigment. The particular feature shown by this series of neurofibrillar changes produced by the cytoplasmic lipochrome accumulation has caused me to name it lipochrome-neurofibrillar degeneration or lipofuscin-neurofibrillar degeneration, (LND for short). As mentioned in the introduction, Bielschowsky, on the other hand, considers the network to be a cytoplasmic formation without relation to the neurofibrils. The occasional finding of intensively silver stained agglutinated neurofibrils in the intrapigmentary network which have lost their connection with peripherally located normal neurofibrils and the incidental persistence of fragments of the

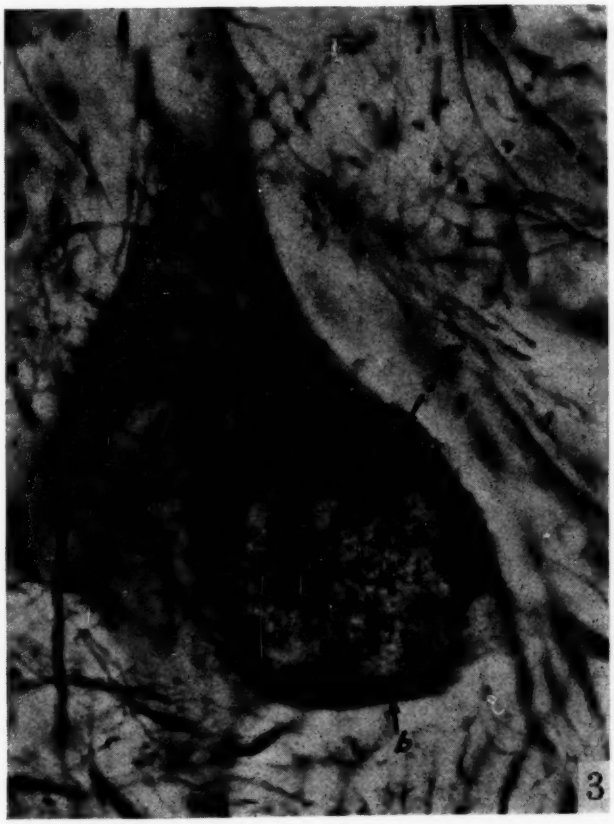


Fig. 3. Photomicrograph of a nerve cell showing an example of the progressive stage of the lipochrome neurofibrillar degeneration. The intrapigmentary network is clearly seen, surrounded by a typical border of peripherally displaced neurofibrils *a* and *b*. Human spinal cord, anterior horn. Reumont's method, X 1000.

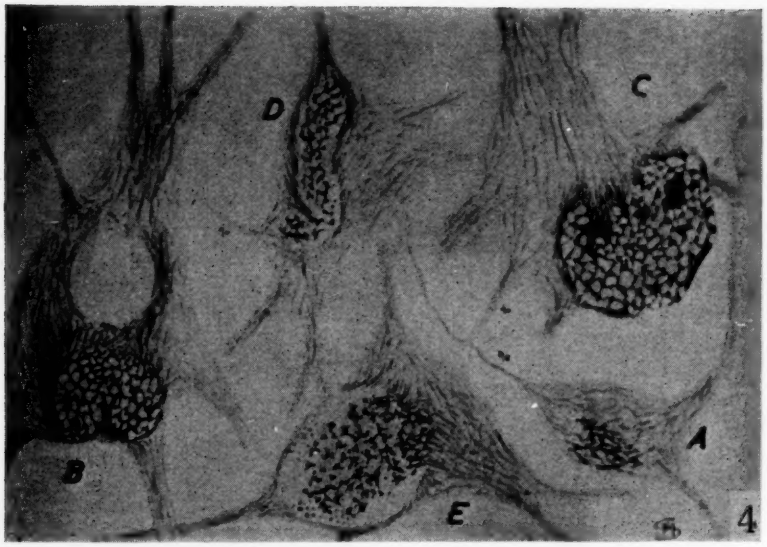


FIG. 4. Drawing of various nerve cells showing different degrees of the lipochrome neurofibrillar degeneration. *A*, initial stage; *B* and *C*, progressive stage; *D* and *E*, regressive stage. *Ax*, axon. In *E* the lipochrome pigment has been stained by osmium tetraoxide.

intrapigmentary network in cells in which the normal neurofibrils have disappeared may supply the explanation for the view held by Bielschowsky.

Although lipochrome accumulation may be found in human individuals suffering from different pathologic conditions, I have been impressed by the fact that the pigment accumulation generally is quite marked in the nerve cells of normal old persons, the intensity and the extension of areas involved apparently increasing with age. This observation in my opinion lends special significance to the lipochrome neurofibrillar degeneration and justifies the contention that the degeneration may be regarded as a characteristic of aging.

## SUMMARY

A special change of the neurofibrillar network occurring in relation to the accumulation of lipochrome pigment (lipofuscin) in the cytoplasm is described and is designated as lipochrome neurofibrillar degeneration or lipofuscin neurofibrillar degeneration (LND for short). The degeneration begins with a dissociation and agglutination of the neurofibrils and ends with total neurofibrillolysis. Three distinct stages of the degenerative process are described. Since the lipochrome neurofibrillar degeneration is found with particular frequency in nerve cells of normal old individuals, it is believed justified to consider it as an aging process.

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# Age Changes in the Maximal Rate of Renal Tubular Reabsorption of Glucose

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PROGRESSIVE decreases in glomerular filtration rate, renal plasma flow, and tubular excretory maxima with increasing age have been described in previous reports (1, 4, 6). The present study was undertaken to evaluate changes in another function of the kidney, the maximal reabsorptive rate of glucose, which occur with aging. A secondary purpose was to evaluate the precision of the experimental technique in the determination of the maximal rate of renal tubular reabsorption of glucose.

## METHODS

Seventy-six male subjects, who ranged in age from 24 to 86 years, were selected for the present study from the wards of the Baltimore City Hospitals and the Baltimore City Infirmary. All subjects were considered to be free of cardiovascular and renal disease on the basis of the following criteria: 1) diastolic blood pressure below 90 mm. mercury, 2) absence of clinical evidence of valvular disease, 3) absence of cardiac enlargement on physical and teleoroentgenographic examination, 4) absence of proteinuria in morning specimen by the heat acetic-acid test, 5) absence of abnormal findings on microscopic examination of sediment of freshly voided urine, and 6) blood non-protein nitrogen below 40 mg. per cent. In addition, subjects who showed fasting glycosuria or a fasting blood sugar level above 100 mg. per cent were arbitrarily excluded from the present study.

The maximal rate of renal tubular reabsorption of glucose was determined by the general procedure outlined by Goldring and Chasis (2). Plasma glucose levels were maintained sufficiently high throughout the procedure so that the ratio of glucose filtration to glucose reabsorption exceeded 1.5 in all cases and 2.0 in most cases. Three to 5 urine collection periods, each of twelve minutes' duration were obtained in all subjects. Urine collection periods were terminated by washing the bladder with 100 cc. of physiologic saline followed by the injection of air to insure complete evacuation. Blood was sampled through an indwelling needle in the femoral artery at the mid-point of each urine collection period.

Determinations of inulin in plasma and urine were carried out by the method of Harrison (3). Plasma and urine glucose determinations were made according to the method outlined by Nelson (5).

The maximal rate of renal tubular reabsorption of glucose ($Tm_G$) for each individual was expressed as the mean of all obtained values corrected to 1.73 sq. M. body surface area. Similarly, the glomerular filtration rate for each individual, as measured by the clearance of inulin ($C_{IN}$), was expressed as the mean of all values for individual urine collection periods corrected to 1.73 sq. M. body surface area.

## RESULTS

The maximal rate of renal tubular reabsorption of glucose showed a progressive decrease with age from a mean of 358.7 mg./min./1.73 sq. M. in the third decade to a mean of 219.2 mg./min./1.73 sq. M. in the ninth decade (table 1; fig. 1). The relationship between $Tm_G$ and age did not differ significantly from rectilinearity ($\epsilon'$)$^2$ = —.092). The correlation

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coefficient of maximal glucose reabsorption on age was —0.61. A regression line calculated by the method of least squares has the following formula: $Tm_G$ (mg./min./1.73 sq. M.) = 432.8 — (2.604 x Age in years). The

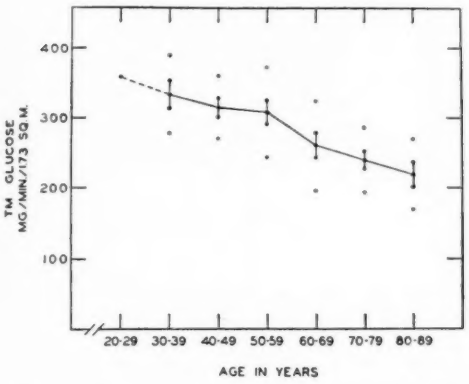


FIG. 1. Decrease in maximal tubular reabsorptive capacity with age. The slope is drawn to connect the mean values for each decade. The vertical lines represent ± one standard error of the mean, while the open circles define the limits of ± one standard deviation of the distribution.

standard error of estimate of $Tm_G$ by the preceding equation is 54.6 mgm./min. When the regression is expressed as per cent decrease each year from a 100 per cent level set arbitrarily at 20 years of age, $Tm_G$ decreased 0.684 per cent of the base line level per year.

The glomerular filtration rate at elevated plasma glucose levels, as measured by the clearance of inulin, showed a similar decrease with age from a mean of 146.0 cc./min./1.73 sq. M. in the third decade to a mean of 81.0 cc./mm./1.73 sq. M. in the ninth decade (table 1; fig. 2). The relationship between filtration rate and age did not differ significantly from rectilinearity $(\epsilon')^2 = -.048$). The correlation coefficient of filtration rate on age was —0.71. The relationship between filtration rate and age in the present series is best expressed by the formula: Glomerular filtration rate (cc./min./1.73 sq. M.) = 150.9 — (0.904 x Age in years). The standard error of estimate is 15.4 cc./min. If the filtration rate at

TABLE 1. AGE CHANGES IN GFR AND $Tm_G$.

| Subject | Age (Years) | GFR (cc./min./1.73 sq. M.) | $Tm_G$ (mg./min./1.73 sq. M.) | GFR / $Tm_G$ |
|---|---|---|---|---|
| | | 20-29 Year Age Group | | |
| E. C. | 26 | 134 | 357 | .375 |
| L. D. | 24 | 146 | 324 | .451 |
| M. R. | 28 | 158 | 395 | .400 |
| Mean | 26.0 | 146.0 | 358.7 | .4087 |
| | | 30-39 Year Age Group | | |
| W. T. | 37 | 128 | 395 | .324 |
| B. R. | 31 | 126 | 383 | .329 |
| C. F. | 32 | 102 | 362 | .282 |
| H. N. | 33 | 110 | 382 | .288 |
| P. T. | 34 | 105 | 236 | .445 |
| H. H. | 35 | 129 | 330 | .391 |
| J. J. | 39 | 115 | 239 | .481 |
| H. G. | 31 | 122 | 320 | .381 |
| W. P. | 39 | 121 | 355 | .341 |
| Mean | 34.6 | 117.6 | 333.6 | .3624 |
| $\sigma_d$ | | 9.49 | 56.27 | .0642 |
| $\sigma_M$ | | 3.36 | 19.90 | .0227 |
| | | 40-49 Year Age Group | | |
| R. W. | 43 | 108 | 324 | .333 |
| G. K. | 41 | 114 | 354 | .322 |
| P. B. | 41 | 121 | 305 | .397 |
| J. B. | 43 | 122 | 362 | .337 |
| R. B. | 44 | 111 | 380 | .292 |
| J. W. | 44 | 96.0 | 318 | .302 |
| J. B. | 49 | 100 | 240 | .417 |
| E. C. | 48 | 103 | 295 | .349 |
| G. M. | 44 | 97.0 | 227 | .427 |
| V. H. | 46 | 102 | 363 | .281 |
| J. C. | 45 | 121 | 316 | .383 |
| F. C. | 45 | 117 | 297 | .394 |
| Mean | 44.4 | 109.3 | 315.1 | .3528 |
| $\sigma_d$ | | 9.27 | 45.22 | .0476 |
| $\sigma_M$ | | 2.79 | 13.63 | .0144 |

20 years of age is arbitrarily taken as 100 per cent, the per cent decrease in filtration rate was 0.681 per cent of the base line level per year.

The ratio of glomerular filtration rate to maximal tubular reabsorption of glucose did

TABLE 1. AGE CHANGES IN GFR AND $Tm_G$—*Continued.*

| Subject | Age (Years) | GFR (cc./min./1.73 sq. M.) | $Tm_G$ (mg./min./1.73 sq. M.) | GFR / $Tm_G$ |
|---|---|---|---|---|
| **50-59 Year Age Group** | | | | |
| E. G. | 50 | 74.6 | 236 | .316 |
| O. R. | 50 | 134 | 425 | .315 |
| R. H. | 55 | 127 | 399 | .318 |
| N. V. | 56 | 107 | 246 | .435 |
| F. B. | 59 | 134 | 452 | .296 |
| R. N. | 54 | 115 | 315 | .365 |
| O. S. | 57 | 76.0 | 268 | .284 |
| J. B. | 53 | 122 | 297 | .411 |
| L. G. | 57 | 103 | 295 | .349 |
| E. H. | 51 | 101 | 268 | .377 |
| J. H. | 59 | 85.6 | 269 | .318 |
| G. H. | 55 | 88.7 | 296 | .300 |
| A. McG. | 52 | 72.0 | 270 | .267 |
| G. A. | 57 | 86.5 | 279 | .310 |
| Mean | 54.6 | 101.9 | 308.2 | .3329 |
| $\sigma_d$ | | 21.14 | 65.04 | .0467 |
| $\sigma_M$ | | 5.86 | 18.04 | .0130 |
| **60-69 Year Age Group** | | | | |
| A. V. | 67 | 92.2 | 359 | .257 |
| W. M. | 65 | 74.1 | 170 | .436 |
| J. K. | 67 | 88.0 | 226 | .389 |
| P. V. | 65 | 71.9 | 210 | .342 |
| J. McK. | 62 | 68.1 | 180 | .378 |
| H. K. | 66 | 87.5 | 256 | .342 |
| M. D. | 67 | 86.0 | 189 | .455 |
| W. J. | 62 | 105 | 265 | .396 |
| W. Y. | 66 | 90.6 | 299 | .303 |
| T. B. | 67 | 89.6 | 271 | .331 |
| W. R. | 61 | 82.0 | 224 | .366 |
| H. C. | 62 | 83.4 | 275 | .303 |
| T. A. | 62 | 136 | 394 | .345 |
| W. J. | 62 | 96.3 | 325 | .296 |
| Mean | 64.4 | 89.4 | 260.2 | .3528 |
| $\sigma_d$ | | 15.97 | 64.58 | .0531 |
| $\sigma_M$ | | 4.43 | 17.91 | .0147 |

TABLE 1. AGE CHANGES IN GFR AND $Tm_G$—*Continued.*

| Subject | Age (Years) | GFR (cc./min./1.73 sq. M.) | $Tm_G$ (mg./min./1.73 sq. M.) | GFR / $Tm_G$ |
|---|---|---|---|---|
| **70-79 Year Age Group** | | | | |
| H. M. | 70 | 84.3 | 256 | .329 |
| P. K. | 72 | 104 | 289 | .360 |
| J. E. | 72 | 112 | 306 | .366 |
| T. K. | 73 | 82.0 | 203 | .404 |
| H. R. | 72 | 73.6 | 198 | .372 |
| H. P. | 73 | 72.9 | 188 | .388 |
| H. T. | 75 | 93.0 | 261 | .356 |
| E. T. | 78 | 63.9 | 128 | .499 |
| C. A. | 75 | 73.9 | 227 | .326 |
| J. M. | 72 | 88.5 | 277 | .319 |
| C. J. | 76 | 69.0 | 226 | .305 |
| T. C. | 71 | 95.1 | 252 | .377 |
| C. B. | 78 | 64.9 | 213 | .305 |
| R. B. | 70 | 95.6 | 290 | .330 |
| G. R. | 74 | 81.5 | 276 | .295 |
| Mean | 73.4 | 83.7 | 239.3 | .3554 |
| $\sigma_d$ | | 13.82 | 46.36 | .0498 |
| $\sigma_M$ | | 3.69 | 12.39 | .0133 |
| **80-89 Year Age Group** | | | | |
| J. H. | 84 | 82.6 | 218 | .379 |
| J. P. | 80 | 110 | 270 | .407 |
| G. E. | 81 | 88.8 | 282 | .315 |
| F. T. | 80 | 96.3 | 250 | .385 |
| N. S. | 80 | 71.4 | 160 | .446 |
| D. McC. | 81 | 48.7 | 143 | .341 |
| E. H. | 86 | 66.6 | 181 | .368 |
| W. R. | 80 | 91.6 | 279 | .328 |
| F. B. | 80 | 72.8 | 190 | .383 |
| Mean | 81.3 | 81.0 | 219.2 | .3724 |
| $\sigma_d$ | | 17.12 | 50.20 | .0383 |
| $\sigma_M$ | | 6.05 | 17.75 | .0133 |

not change significantly with age ($\epsilon^2 = .012$) (table 1; fig. 3).

The magnitude of experimental error in the determination of $Tm_G$ and glomerular filtration rate was quantitated by an analysis of variance. The data employed for the analysis was that obtained in 40 subjects, each of whom had 4 consecutive urine collection periods of twelve minutes' duration. The interaction variance between periods and individuals is a measure of random variation between urine collection periods in an individual after corrections for differences between individuals and possible systematic differences between periods have been made. For the entire group of 40 subjects, without regard for age, measurements on successive urine collection periods in an individual will be distributed around the mean with a standard deviation of 5.01 cc./min. for

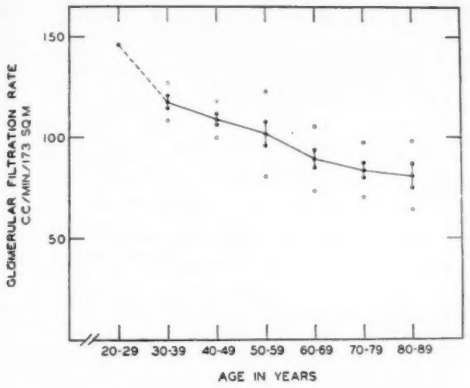


FIG. 2. Decrease in glomerular filtration rate with age. The slope is drawn to connect the mean values for each decade. The vertical lines represent ± one standard error of the mean, while the open circles define the limits of ± one standard deviation of the distribution.

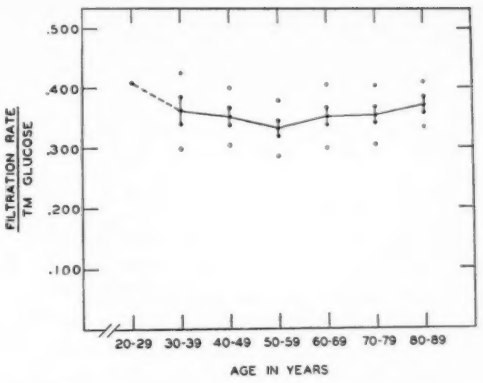


FIG. 3. Glomerular filtration rate per unit of glucose Tm with age. The slope is drawn to connect the mean values for each decade. The vertical lines represent ± one standard error of the mean, while the open circles define the limits of ± one standard deviation of the distribution.

inulin clearance (the square root of the individual x period interaction variance) and 23.35 mg./min. for glucose Tm.

In table 2, the interaction variance is broken down by age groups, and the standard error per urine collection period, together with the mean values for both $C_{IN}$ and $Tm_G$ are tabulated by age groups. It is apparent that, although older subjects show less period to period variation, the percentage variation as expressed by the coefficient of variation $\left(\frac{\sigma}{M}\right)$ is unchanged with age.

## DISCUSSION

The progressive decrease with age in the capacity of the renal tubules to reabsorb glucose is in accord with age changes in other functions of the kidney, viz., filtration rate, plasma flow, and tubular excretory maxima, which have been described previously.

It is of interest that the rate of decrease in tubular reabsorptive capacity for glucose in the present study, when expressed percentagewise, agrees almost exactly with the rate of

TABLE 2. RANDOM PERIOD TO PERIOD VARIABILITY IN GFR AND $Tm_G$ BY AGE GROUPS.

| Age Group | AGE | | | GFR | | | $Tm_G$ | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Age Range (Years) | Mean Age (Years) | Mean (cc./min.) | $\sigma$* (cc./min.) | $\frac{\sigma}{M}$ x 100 | Mean (mg./min.) | $\sigma$* (mg./min.) | $\frac{\sigma}{M}$ x 100 |
| I | 13 | 24-43 | 35.8 | 120.5 | 6.35 | 5.27 | 328.3 | 27.71 | 8.44 |
| II | 12 | 44-59 | 51.4 | 100.9 | 5.03 | 4.98 | 301.7 | 23.15 | 7.67 |
| III | 12 | 60-72 | 67.8 | 87.6 | 4.44 | 5.07 | 258.3 | 21.39 | 8.28 |
| IV | 13 | 73-86 | 78.4 | 80.8 | 3.84 | 4.75 | 223.8 | 19.33 | 8.64 |

* $\sigma = \sqrt{}$ individual x period interaction variance.
All values used in calculation corrected to 1.73 sq. M. body surface area.

decrease in tubular excretory capacity for diodrast (1).

It should be noted that no specific impairment of function of the individual renal tubular cells has been demonstrated in the present study. The decrease in total reabsorptive capacity which occurs with age may well be due to a decrease in the number of nephrons on the basis of vascular impairment. Indeed, the identity of the regression slopes for both filtration rate and tubular resorptive maxima on age (—0.68 per cent per year from the level at 20 years for each function) is evidence that overall glomerular function and tubular function decrease with age at the same rate and suggests that the nephron loses its function as a unit.

Although no change in overall glomerular-tubular balance occurs with age, no conclusions with regard to the distribution of individual nephron balances about the mean can be drawn from the present data.

## Summary

The glomerular filtration rate and the maximal rate of renal tubular reabsorption of glucose were determined in 76 subjects who ranged in age from 24 to 86 years. All subjects studied were adjudged to be free of cardiovascular and renal disease as well as gross abnormalities of carbohydrate metabolism.

Both glomerular filtration rate and the tubular resorptive capacity for glucose showed a linear decrease with age. Filtration rate at elevated plasma glucose levels decreased from a mean of 146.0 cc./min./1.73 sq. M. in the third decade to a mean of 81.0 cc./min./1.73 sq. M. in the ninth decade ($r = -0.71$). The maximal rate of glucose reabsorption decreased from a mean of 358.7 mg./min./1.73 sq. M. in the third decade to a mean of 219.2 mg./min./1.73 sq. M. in the ninth decade ($r = -0.61$). The regression of function on age when expressed as per cent decrease from the level of function at 20 years of age was —0.68 per cent of the base line level per year for both filtration rate and tubular reabsorption of glucose.

Period to period random variations in both measurements have been quantitated by an analysis of variance. Period to period variability (standard error per urine collection period) was 5.01 cc./min. for inulin clearance and 23.35 mg./min. for glucose Tm. The decreases in random variability with age paralleled the decreases in mean values for filtration and tubular reabsorption which occurred with age.

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# The Age Trend of Serum Concentrations of Cholesterol and of $S_f$ 10-20 ("G") Substances in Adults

ANCEL KEYS

THE total cholesterol concentration in blood serum shows a pronounced age trend in clinically healthy men (11, 13). Measurements of the serum concentration of Gofman's (8, 9, 10) "$S_f$ 10-20 molecules" ("G" substances) likewise show a pronounced age trend in such men. It is of interest to examine and compare these age trends with care in order to establish their validity, to clarify the relationship between the concentrations of cholesterol and the G substances in the serum, and to consider the relationship of the findings to the development of atherosclerosis. The analytic methods have been reported elsewhere (8, 13).

## THE CHOLESTEROL AGE TREND

Figure 1 shows the mean values of total cholesterol in the serum in 1492 "normal" men, without complaints, who were judged to be clinically healthy from detailed clinical and laboratory examinations on the day of blood sampling. These men were all in the urban "white collar" class and were actively engaged in business, professional, and college work. Figure 1 also shows mean values computed from data in the literature on some 400 healthy men at New York (17), Rochester, Minnesota (2), San Francisco Bay Area (3), and Denmark (14). The age trends indicated by these points are reasonably consistent with that obtained in the present series.

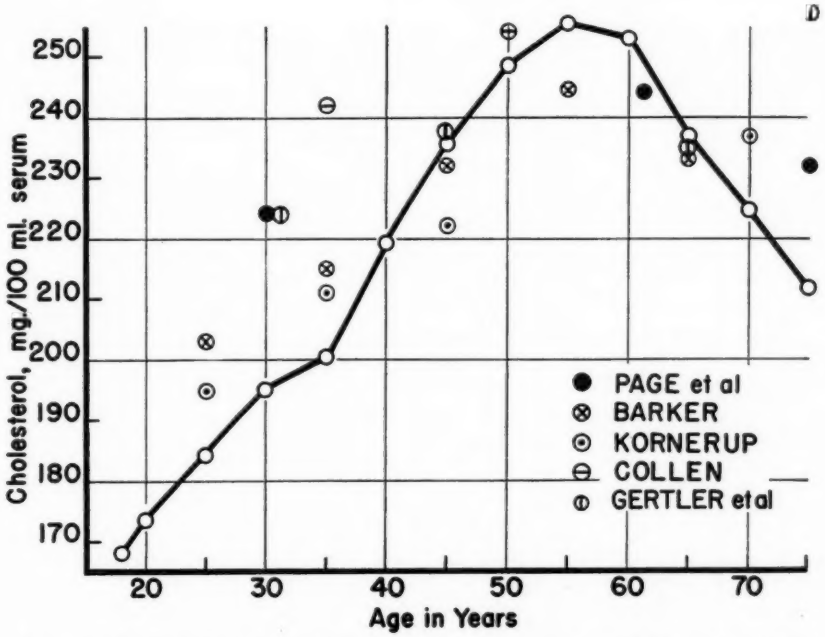


FIG. 1. The mean total cholesterol concentration in the serum of healthy men at different ages. The open circles and connecting heavy line show the trend for 1492 men in the Twin Cities.

There is a large inter-individual variation in the serum cholesterol concentration in healthy men of the same age, the standard deviation being of the order of 40 mg. per 100 ml. (13). However, the rather large numbers of men involved in the mean line in figure 1 results in relatively small standard errors about the mean, as shown in figure 2. In figure 2, besides the mean, there are shown the lines of ± 1.0 standard deviation and of ± 1.0 standard error. It should be noted that, with the possible exception of the value from Collen for the fourth decade, none of the points in figure 1 differs significantly from the present mean line. This results from the fact that the standard errors of the points in these other series are much larger than in the present series.

### The Age Trend in G

In 1950 Gofman and his associates (8) indicated the age trend for G concentration in the serum by bar diagrams of the arithmetic averages of the different age groups of "healthy" males and females. The actual individual data, however, can be read off of his figure 4 (8) from which it is clear that the distribution is extremely skewed but to different degrees in the several age groups, so the means have restricted utility for analysis. Moreover, for men up to 30 years old the median is included in the general category of readings at or below the limit of resolution. To a limited degree the age trend may be represented by the values for the third quartile.

More recently, the Berkeley group have changed their calibration system and the result is a marked change in both general level and frequency distribution (9, 10). The new frequency distributions, which can be computed from Gofman's figure 4A (9) or Gofman and associates' (10) figure 4, are still far from those of a normal probability curve and the distributions for the several ages are variable, so again it would be hazardous to portray the age trend with the means. However, more

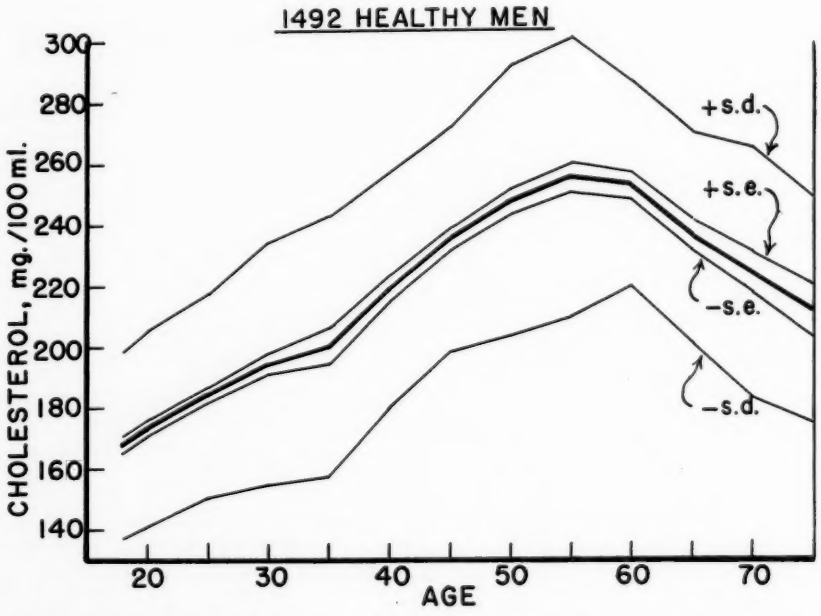


Fig. 2. Mean serum total cholesterol and age, together with the lines for ± the standard deviation and ± the standard error.

acceptable portrayal can be given by the quartiles as indicated in table 1.

TABLE 1. AGE TREND OF "G" SUBSTANCES IN ADULTS.

| Age | G 1 | | G 2 | | G 3 | | Chol. |
|---|---|---|---|---|---|---|---|
| | Mg. | % | Mg. | % | Mg. | % | % |
| 21-30 | 18 | 100 | 42 | 100 | 44 | 100 | 100 |
| 31-40 | 28 | 156 | 44 | 105 | 53 | 120 | 111 |
| 41-50 | 28 | 156 | 54 | 128 | 47 | 107 | 128 |
| 51-60 | 30 | 167 | 61 | 144 | 63 | 143 | 139 |
| 61-70 | 22 | 122 | 55 | 131 | 56 | 127 | 127 |

Values for the third quartile (including the lower 75 per cent) of the G distribution, in milligrams of G per 100 ml. and in percentage of the value for the decade 21 to 30 (centered at age 25). Also values for the third quartile of the cholesterol distribution in percentage of the value at age 25. "G 1" and "G 2" values computed from (8) and (10), respectively. "G 3" is computed from a revision supplied by Gofman for the data in (9). All values are for healthy white males.

There was a serious inconsistency in the normal data within references (9) and (10); this will be observed by comparing the values for normal men in figure 4 with those in figure 6 (reference 10). This was called to the attention of the Berkeley group and they have supplied, with the reprint of reference (10), a new figure 4 which indicates a still different age trend, which is also summarized here in table 1.

Since it is claimed that the development of atherosclerosis tends to be associated with high values of G, it would appear that the third quartile might be the most important part of the G distribution. It is convenient, then, that the age trend for the third quartile is much the same in all three of the sets of G data, with a minimum value in the third decade, a maximum in the sixth decade, and a lower value thereafter.

## COMPARISON OF G AND CHOLESTEROL AGE TRENDS

In view of the uncertainties about G values and frequency distributions, at different ages, no detailed comparison with the cholesterol age trend is justifiable. The third quartile cholesterol values for healthy men of different ages are given in table 1 and it is obvious that the general character of the trend is similar to that for G. Statistically, we cannot demonstrate a significant difference in the third quartile trend for cholesterol as compared with that for G 2 or G 3 (in table 1), with the possible exception of the point for 41 to 50 years in G 3. For many purposes, then, it would seem that the cholesterol age trend, which is far more accurately established, may also serve to represent the G trend.

## THE CHOLESTEROL TREND AFTER AGE 50

One of the striking features in the cholesterol age trend is the change in the fifties. The linear increase with age, which is evident after age 18, is reversed at around age 55. This phenomenon also appears in the G data.

It should be noted that all of the findings discussed so far have been obtained from studies on healthy men of different ages and not on the same individuals as they grow older. There are really two possibilities: 1) the trends in figures 1 and 2 actually depict the ordinary ontogeny of the healthy individual man; 2) the trends observed reflect a selective or differential morbidity and mortality in which disability and death do not take a random sample of cholesterol concentrations. Of course the third possibility must also be entertained, namely, that individual men tend to show lower cholesterol values as they age beyond the fifties and also that selective mortality operates on cholesterol levels.

A full analysis of this question would require a prolonged longitudinal study on a considerable number of men but significant indications of the possibilities can be gained from data presently at hand. We have cholesterol values on healthy middle-aged men who have remained healthy and who have been studied annually for four years, so we may observe the changes, if any, after three elapsed years.

There are 54 men who were 46 or 47 years old when first seen and 48 men who were 54

or 55 years old when first seen. The essential data are summarized in table 2. In three elapsed years the younger middle-aged men showed a mean change of + 12.13 mg. of total cholesterol per 100 ml. of serum, while the older men showed a change of —4.77 mg., the total difference being 16.84 ± 5.65 mg. This is statistically highly significant and we may state confidently that the age trend is different from 54 to 58 as compared with 46 to 50 years of age. Moreover, the values from this longitudinal study are not significantly different from those predicted from the data obtained in the cross-sectional survey reported previously (13); the differences between the observed and the computed values in table 2 are not significant.

TABLE 2. CHANGES IN SERUM TOTAL CHOLESTEROL CONCENTRATION (MILLIGRAMS PER 100 ML.) IN HEALTHY MEN IN THREE ELAPSED YEARS. MEANS AND STANDARD ERRORS, AS OBSERVED AND AS COMPUTED FROM KEYS AND ASSOCIATES, (13, TABLE III).

| Initial Age | Number | Observed | | Computed | |
|---|---|---|---|---|---|
| | | Mean Δ | ± S. E. | Mean Δ | ± S. E. |
| 46-47 | 54 | +12.13 | 3.75 | +7.8 | 5.8 |
| 54-55 | 48 | − 4.71 | 4.22 | −1.4 | 6.3 |

From the foregoing it seems that it is unnecessary to have recourse to the idea of selective mortality to explain the change in the cholesterol trend after age 50. However, it does not follow, necessarily, that there is no selective mortality in regard to cholesterol. Actually, there is good reason to believe that one major cause of death—coronary disease—operates so as to bring about a selective morbidity and mortality in regard to the serum cholesterol level in the population.

## SELECTIVE MORTALITY AND THE CHOLESTEROL AGE TREND

All recent studies are in agreement that patients with coronary disease tend to have higher serum cholesterol values than do healthy men (3, 5, 7, 16, 20). Serum cholesterol measurements have value in predicting the incidence of coronary disease in groups of men, although the prediction is unreliable for individuals, and in these respects cholesterol is at least as good a discriminator as is G (1, 12, 15). The average difference between healthy men and men of the same age with evident coronary disease is of the order of 50 mg. of total cholesterol per 100 ml. of serum (7). This corresponds roughly to the difference, in healthy men, between ages 35 and 50.

Consider a population of 45 year old men in whom coronary disease is not evident clinically. Some of these men, however, will be developing serious atherosclerosis and will, on the average, have higher cholesterol levels than their fellows. The average cholesterol concentration in a sample of this population will, of course, be affected by this fact. Now, ten years later if a sample of men aged 55 is drawn from the population it will be made up of the survivors, that is, those men still alive and who still do not exhibit signs of coronary disease. The men eliminated by coronary disease in the interim will tend to be characterized by having a higher cholesterol level in the serum than their fellows and we may estimate this difference to be of the order of 50 mg. per 100 ml. The original sample of men will tend to have a higher average value than the average, at age 45, of the men destined to survive and remain free of clinical signs of coronary disease to age 55.

The magnitude of this effect will be dependent on the new incidence of coronary disease in the years between 45 and 55. At present there are no reliable data on this point but there are data from which rough approximations can be computed.

Death rates from coronary disease in men at different ages can be computed from the U. S. Vital Statistics (4, tables S, IX, and 4). And there are several studies on the survival after onset and after diagnosis of coronary disease (18, 19). The computations made possible by these data are too lengthy to re-

capitulate here but they indicate that a healthy population of 100,000 45 year old white men will be represented ten years later by some 86,000 healthy men, and among those eliminated will be something less than 3000 men who will have developed coronary disease and be either dead from it or will exhibit the disease. In other words, not over 3 per cent of the original sample of 45 year old men were individuals who would not be included in the later sample and who tended, on the average, to have high cholesterol values.

If we assume that the 3000 men thus to be eliminated had an average of 50 mg. more cholesterol than that of the entire 100,000 men at age 45, it is obvious that the other 97,000 men would have had an average cholesterol level of $(100 \times 235.5 - 3 \times 286.5)/97 = 233.9$, taking the value of 235.5 as the average for healthy white men 45 years old (13). But the average for a sample of healthy 55 year old white men is 255.7, so the change in the same men from age 45 to age 55 is $255.7 - 233.9 = 21.8$ instead of 20.2 mg. as estimated without this consideration. This computation gives a maximum estimate of the discrepancy and it assumes, as seems reasonable, that the net effect of all causes of death and disability other than coronary disease in the period of ten years will not operate differentially in regard to cholesterol concentration.

Obviously, this selectivity is trivial in its effect on population estimates in the range 45 to 55 years of age. However, it is interesting to examine the situation in the decade 55 to 65 years of age. Here the limiting computation indicates a maximum of about 6 per cent of the healthy men aged 55 being eliminated from coronary disease by age 65. The correction, made as at ages 45 to 55, indicates that the healthy men seen at age 65 will have changed from age 55 by —15.8 mg. instead of —21.0 mg. as estimated from cross-sectional surveys. In other words, the average decline in the healthy man from ages 55 to 65 is about 25 per cent less than the average difference between samples of men aged 55 and 65 drawn at the same time from the general healthy population. The effect is not negligible but it would not be reflected with statistical significance in the data given in table 2. Table 2 is not inconsistent with selective effects estimated for these decades 45 to 55, 55 to 65.

## Summary


1. An analysis is presented of the trend with age in healthy men of serum concentrations of total cholesterol and of "$S_f$ 10-20 molecules" ("G").
2. When samples of healthy men of different ages are compared it is found that the cholesterol and G concentrations are lowest in early adulthood, rise to a maximum in the fifties, and show lower values in the sixties. The trends in G and in cholesterol are not significantly different on the basis of present data.
3. The difference in the cholesterol means at 50 and at 35 years of age is of the same order of magnitude as the difference in men of the same age who do and who do not show definite indications of coronary disease.
4. Healthy men, who remained healthy over four successive years of study, exhibited cholesterol age trends—rising in the forties and falling in the late fifties—similar to those observed in surveys of men of different ages.
5. An analysis is made of the possible effect of differential mortality on cholesterol averages in population samples as contrasted with the trend in individuals.



The cholesterol measurements in the middle-aged men were made by Miss Erma v.O. Miller.

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# Hematologic Values in the Aged

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INFORMATION about the normal range of hematologic values in elderly people is incomplete. Many of the published reports record data for only a small number of subjects, deal largely with erythrocyte and hemoglobin levels, fail to describe methods used, and ignore qualitative morphologic changes. There have been almost no systematic studies of the total blood volume, of the various factors related to hemostasis, and of reticulocyte percentages. Furthermore, observers have found it difficult to select, for persons above the age of 60 years, a representative sample of the population, free of disease except for those degenerative changes which may be considered "normal" in the aged. For these reasons, the material summarized in this paper can only indicate either: 1) the approximate range of normal values, or 2) the areas where information is particularly scanty. A few of the published reports have not been included in the tabulations because description of methods or of subjects was inadequate. Values obtained from the literature have been supplemented by observations made in this laboratory on the blood of 50 men and 50 women, 60 years of age or older.

## Material and Methods

Fifty male and 50 female subjects ranging from 60 to 95 years of age were studied. Their records indicated that they were free of any known or recognized disease except for degenerative changes, e.g., arteriosclerosis, atrophic skin, degenerative arthritis. A few showed some of the complications of these changes such as Parkinsonism, residual hemiparesis, mild essential hypertension, and mental deterioration. One had mild, well-controlled diabetes. The Kahn test was negative in all subjects; the NPN slightly elevated in a few. Most subjects were inmates of the St. Louis City Infirmary; a few were patients in the Barnes Hospital.

Oxalated (34) venous blood, obtained without stasis between 5:30 and 6:00 a.m. before the subjects had gotten out of bed or had been served breakfast, was used for all determinations except differential, reticulocyte, and platelet counts. Preparations for the latter were made from free-flowing capillary blood. Red and white blood cell counts were done, using pipettes and hemocytometers standardized by the U. S. Bureau of Standards. Hemoglobin was determined as oxyhemoglobin with a standardized Evelyn photocolorimeter (10). For packed red cell volume, blood was placed in a Wintrobe tube and centrifuged for thirty minutes at 3,000 r.p.m. Reticulocyte and platelet counts were made by the wet technique, using Dameshek's method (5). Coverslip preparations for differential counts and cytologic study were stained both with Wright and supravital stains. Sedimentation rates were read at sixty minutes in Wintrobe tubes, and were corrected for variations in the packed cell volume (34).

## Bone Marrow

During childhood, there is a gradual decrease in the amount of red, hematopoietically active marrow with a concomitant increase in yellow or fatty marrow. The extent to which this process continues after adult life has been reached, particularly in the aged, is not known with certainty. Custer and Ahlfeldt (4) attempted to obtain such information by studying the cellularity of the marrow obtained during 100 autopsies, including 19 performed on persons above the age of 60 years. They cau-

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tioned that their results were only approximations and presented them in graphic form (fig. 1). The graphs, however, suggest that there is a slight tendency for the marrow in the flat bones to become progressively less cellular with advancing years.

Most studies have been made on marrow aspirated from a single bone and must be interpreted with caution because the specimens obviously provide inadequate sampling of the whole marrow volume. Reich, Swirsky, and Smith (26) concluded, from observations on sternal marrow aspirated from 100 subjects of both sexes between the ages of 65 and 90 years, that the bone marrow is relatively unchanged in the aged and in some instances may actually show increased cellularity. Sacchetti (28), in 26 cases 63 to 95 years of age, noted active myelopoiesis and erythropoiesis in spite of variable amounts of fat. Plasma cells, eosinophils, and megakaryocytes were said to be increased in the majority of instances. Occasionally there was also an increase in lymphocytic elements. Cheli and Giordano (2) examined marrow specimens from 21 patients (60 to 90 years); they found no constant decrease in cellularity and in some instances observed an apparent stimulation. Plum (24) was not able to detect any definite relationship between age and the cellular com-

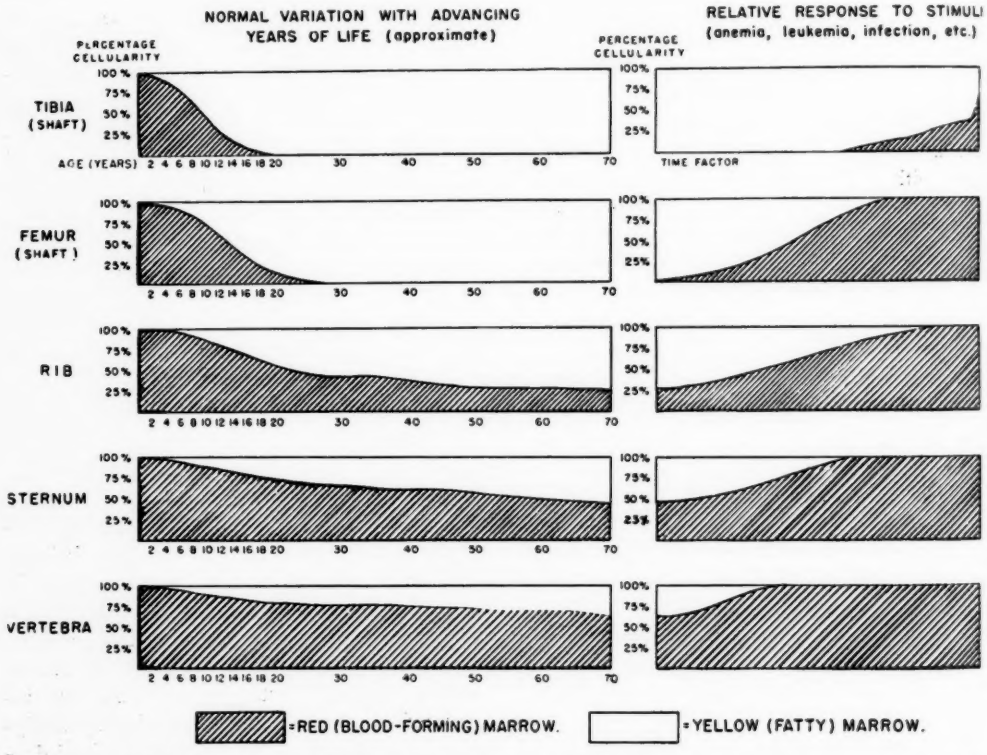


FIG. 1. Cellularity of Various Bones at Different Ages. (Reprinted with permission from *An Atlas of the Blood and Bone Marrow*, by R. Philip Custer, W. B. Saunders Co., Publishers, Philadelphia, 1949).

The first section of this diagram represents the regression of hematopoietic tissue (with advancing age) and its replacement by fatty marrow in representative long and flat bones. It is based on a series of autopsies on persons who died from causes unlikely to have affected the blood-forming organs. The second section illustrates the relative responses of these same bones to hematopoietic stimuli, such as anemia, leukemia, or infection, regardless of age.

position of sternal marrow. Segerdahl (29), however, described a decrease in the number of active bone marrow cells which she thought was due to the increasing number of fat cells.

About the only conclusion one can draw from the published reports is that there probably is a tendency for the ratio of red to fatty marrow to decrease in people of advanced age; no other significant change has been observed.

### Total Blood Volume

Published data on the blood volume in old age are extremely scanty. Gibson and Evans (13) included 7 men and 3 women above the age of 50 years in their series of 90 subjects on whom blood volume was determined by the dye (T-1824) method. When all of their results were analyzed by decades, there seemed to be a tendency for average values to decline with advancing years. The decrease in women after the fourth decade averaged 16 per cent below middle age values, while in men it was 8 per cent. Cohn and Shock (3) utilized the T-1824 dye method with ten minute sampling to determine the blood volume on 60 normal males above the age of 50 years. The mean plasma volume was 48.0 cc. per kilogram body weight with extreme values of 31.29 and 62.47 cc. The range in total blood volume was from 54.33 to 100.6 cc. per kilogram of body weight. The mean values by decades for the total blood volume were (in cubic centimeters per kilogram): 86.09 from 50 to 59 years; 78.33 from 60 to 69 years; 80.71 from 70 to 79 years; 82.84 for 80 years and over. There was in these studies, therefore, no significant change with increasing age. The total number of observations, however, is still too few to permit any generalizations.

### Erythrocyte Values

Investigators who have studied the blood in people of advanced age have focused more on the erythrocyte than on any other component. A composite summary of the 13 most extensive studies is given in table 1. Also included for comparison are the values reported by Wintrobe (33) and by Osgood (23) for red cells and hemoglobin in healthy young adults.

Close inspection of the data tabulated in table 1 shows that the range of variation from minimum to maximum values is greater than usually is obtained in similar studies made on younger age groups. This fact suggests that subjects were included who had diseases other than those common to the aging process. From the published reports, it is also evident that there was considerable difference in the technical care used by various workers in the collection of data.

Furthermore, some of the results indicate that erythrocyte values are lower in persons above the age of 60 years, while others failed to show such a difference. For instance, Newman and Gitlow (19), Fowler, Stephens, and Stump (11), Miller (17), Millet and Balle-Helaers (18), and Rud (27) concluded that the red blood cell counts and packed cell volumes (when measured) were less than in young adults. These same workers, with two exceptions (18, 27), also reported lower hemoglobin values. Olbrich (21) found a slight decrease in the erythrocyte and hemoglobin levels in elderly males but noted no essential change in women. Our own results were similar. Hansen (14) stated that the hemoglobin may fall slightly in older people without there being an associated change in the red cell count, but cautioned that any value more than a few per cent less than normal should be investigated.

The remaining studies (1, 7, 25, 31, 32), on the other hand, showed no significant change in the number of red cells or the amount of hemoglobin as compared with younger age groups. In addition, Sjöstrand (30) determined the total amount of hemoglobin in the body of 266 adults; only a few of his subjects were above the age of 50, but the total hemoglobin seemed to remain constant throughout adult life. The mean value was calculated for all the red cell counts in table 1

TABLE 1. ERYTHROCYTE VALUES.[1]

| Author | Age Range (Yrs.) | Sex and No. of Cases[1] | RBC/ (millions/mm³) Max. | Min. | Mean | Hb. (Gm./%) Max. | Min. | Mean | Reticulocytes % Max. | Min. | Mean | Packed Cell Volume % Max. | Min. | Mean | MCV Cu. Microns Max. | Min. | Mean | MCHb. Gamma Gamma Max. | Min. | Mean | MCHb. Conc. % Max. | Min. | Mean | Hb. Method |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *I. Values for Normal Young* | | *Adults* | | | | | | | | | | | | | | | | | | | | | | |
| 1. Wintrobe (max. and min. = range of normal) (33) | M. F. Adults | M. 544 RBC 583 Hb. 381 PCV | 6.2 | 4.6 | 5.4 | 18 | 14 | 16 | .. | .. | .. | 54 | 40 | 47 | 94 | 80 | 87 | 32 | 27 | 29.5 | 38 | 33 | 35 | Newcomer |
| | | F. 387 RBC 433 Hb. 313 PCV | 5.4 | 4.2 | 4.8 | 16 | 12 | 14 | .. | .. | .. | 47 | 37 | 42 | | | | | | | | | | |
| 2. Osgood, (23) | M. 14–30+ | M. 259 RBC, Hb. 153 PCV 110 retics | 6.2 | 4.6 | 5.42 | 18 | 14 | 15.8 | 3.0 | 0.5 | 1.46 | 50 | 40 | 44.8 | .. | .. | .. | .. | .. | .. | .. | .. | .. | Osgood-Haskins |
| | F. 14–30+ | F. 152 RBC, Hb. 106 PCV 50 retics | 5.4 | 4.2 | 4.83 | 16 | 11.5 | 13.9 | | | | 45 | 36 | 41.0 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| *II. Values for Healthy Aged* | | *Persons* | | | | | | | | | | | | | | | | | | | | | | |
| 1. Newman & Gitlow (19) | 65–104 | M. 50 | 5.09 | 3.30 | 4.42 | 15 | 9.7 | 12.65 | 1.8 | 0.14 | 0.53 | 52.2 | 35 | 41.2 | 121 | 81.3 | 97.7 | 30.6 | 26.5 | 28.5 | 35.4 | 24.5 | 29.6 | Sahli |
| | | F. 50 | 5.21 | 3.20 | 4.11 | 16 | 7.8 | 11.7 | 1.26 | 0.17 | 0.64 | 52 | 25 | 36.7 | 123 | 67.5 | 90 | 32.8 | 26.5 | 28.8 | 40.7 | 26.4 | 32.3 | |
| 2. Olbrich (21) | >60 | M. 41 RBC, Hb. 38 PCV, MCV | 6.19 | 3.98 | 5.07 | 17.4 | 11.0 | 13.9 | .. | .. | .. | 50 | 37 | 45.1 | 97.5 | 79.4 | 89.5 | .. | .. | .. | .. | .. | .. | Haldane-Gower |
| | | F. 48 RBC 47 Hb. 46 PCV, MCV | 5.69 | 3.65 | 4.76 | 16.0 | 9.9 | 13.2 | .. | .. | .. | 52 | 26 | 42.0 | 100.4 | 60.6 | 88.4 | .. | .. | .. | .. | .. | .. | |
| 3. Fowler, Stephen & Stump(11) | 65–80 | M. 73 | .. | .. | 4.61 | 16.0 | 9.7 | 13.1 | .. | .. | .. | 54 | 33 | 41.7 | .. | .. | .. | .. | .. | .. | .. | .. | .. | Newcomer |
| | | F. 27 | .. | .. | 4.46 | | | 12.5 | .. | .. | .. | | | 40.4 | .. | .. | .. | .. | .. | .. | .. | .. | .. | Haden-Hauser |
| 4. Miller (17) | 60–104 | M. 160 | 5.5 | 3.5 | 4.46 | 17.5 | 12.0 | 14.3 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Hellige |
| 5. Bing (1) | >60 | M. 22 | 9.8 | 4.9 | 6.1 | 120% | 88% | 104% | ... | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Not Given |
| | | F. 21 | 6.4 | 4.2 | 5.1 | 115% | 84% | 96% | | | | | | | | | | | | | | | | |
| 6. Hansen (14) | 63–95 | M. 20 | 6.3 | 4.2 | 5.1 | 15.2 | 10.4 | 13.0 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Sahli |
| | | F. 20 | 5.8 | 3.9 | 5.0 | 13.8 | 10.4 | 12.4 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 7. Millet & Balle-Helaers (18) | 57–95 | M. 53 | 5.32 | 2.32 | 3.99 | 120% | 57% | 93.1% | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Sahli |
| | | F. 41 | 6.02 | 2.84 | 3.96 | 117% | 70% | 93.1% | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |

TABLE 1. ERYTHROCYTE VALUES[1]—Continued.

| Author | Age Range (Yrs.) | Sex and No. of Cases[1] | RBC/ (millions/mm³) Max. | Min. | Mean | Hb. (Gm./%) Max. | Min. | Mean | Reticulocytes % Max. | Min. | Mean | Packed Cell Volume % Max. | Min. | Mean | MCV Cu. Microns Max. | Min. | Mean | MCHb. Gamma Gamma Max. | Min. | Mean | MCHb. Conc. % Max. | Min. | Mean | Hb. Method |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8. Rud (27) | 63–90 | M. 7 | 5.50 | 4.40 | 5.10 | 106% | 86% | 100% | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Autenrieth & Konigsberger Colorimeter |
| | | F. 5 | 5.37 | 4.28 | 4.68 | 94% | 82% | 89% | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 9. Williamson (32) | 61–76+ | M. 81 | .. | .. | .. | .. | .. | 15.82 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Spectrophotometric |
| | | F. 71 | .. | .. | .. | .. | .. | 15.39 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 10. Ventura (31) | 63–91 | M. 20 | 6.12 | 4.37 | 5.04 | 102% | 60% | 88.5% | 1.06 | 0.14 | 0.57 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Sahli |
| | | F. 20 | 6.97 | 3.65 | 4.90 | 110% | 71% | 91.9% | 1.61 | 0.16 | 0.62 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 11. Puxeddu, (25) | 60–90 | M. 55 | 6.10 | 4.00 | 5.37 | .. | .. | .. | .. | .. | .. | 50 | 40 | 43.6 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| | | F. 39 | 6.00 | 4.00 | 4.83 | .. | .. | .. | .. | .. | .. | 50 | 40 | 43.1 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 12. Dotti, (7) | 60–95 | M. 26 | 6.46 | 4.39 | 5.16 | 109% | 70% | 93% | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| | | F. 35 | 5.26 | 4.07 | 4.59 | 95% | 76% | 83% | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 13. Shapleigh & Mayes | 60–95 | M. 50 | 5.96 | 3.72 | 4.75 | 17.2 | 10.9 | 14.1 | 4.2 | 0.2 | 2.01 | 51 | 34 | 42.1 | 110 | 74 | 89.2 | 33 | 24 | 29.8 | 36 | 27 | 33.5 | Evelyn Colorimeter. Oxyhemoglobin |
| | | F. 50 | 5.55 | 3.65 | 4.71 | 16.2 | 11.6 | 13.7 | 3.6 | 0.4 | 1.66 | 46 | 35 | 40.8 | 101 | 78 | 87.3 | 34 | 25 | 29.2 | 36 | 30 | 33.5 | |

| Mean Values | | | | | |
|---|---|---|---|---|---|
| M. (577) 4.73 | M. (475) 14.09 | | M. (266) 43.69 | | |
| F. (356) 4.58 | F. (265) 13.47 | | F. (212) 40.46 | | |

[1] In the column under "Sex and No. of cases," the figures refer to the number of subjects on whom each determination was made. Hemoglobin values are recorded in grams per 100 cc. except where "%" is indicated. In the mean values at the bottom of the table, the figures in parentheses indicate the number of subjects included in the calculation of mean values. For calculation of mean hemoglobin, only values reported in grams were used.

and for all of the hemoglobin levels reported in grams per 100 cc. These mean values differ from those given by Wintrobe and Osgood for healthy young adults in two ways: they are slightly lower and they show less difference between the two sexes.

There are fewer data for the packed red cell volume (table 1). The average mean values, however, are slightly lower than those recorded for younger age groups. Corpuscular constants were calculated by only 3 groups of investigators. Newman and Gitlow's figures (19) for mean corpuscular volume were slightly above, and those for mean corpuscular hemoglobin concentration slightly below usually accepted normal values. Our figures were within the normal range. Olbrich (21) and Millet and Balle-Helaers (18) described a definite increase in mean cell diameter, whereas Fowler, Stephens, and Stump (11) stated that there was no change. The reticulocyte levels reported in 3 studies show no significant deviation; the counts obtained by us are slightly higher than those reported by Newman and Gitlow (19) and by Ventura (31), but that is frequently true when wet rather than fixed reticulocyte preparations are used.

In order to determine whether there was any further tendency for erythrocyte values to change with advancing age, the data collected on the 100 subjects in the present study were plotted on a scatter diagram (fig. 2). The graphs demonstrate clearly that there is no consistent rise or fall in the red cell, hemoglobin, hematocrit, or reticulocyte values in the age range of 60 to 90 years. These figures have also been submitted to statistical analysis for determination of the standard deviation. The results are summarized in table 2.

Little mention is made in the literature of qualitative changes in the erythrocytes of aged people. Anisocytosis, poikilocytosis, and polychromasia are apparently not found to any degree; this was true also in the 100 subjects in the present investigation. The osmotic fragility of the red cells is somewhat increased according to Olbrich (21), but is normal according to Newman and Gitlow (19). It would be of interest to know whether the relatively sedentary life of the aged causes red cells to have less trauma in circulation and leads to a longer life span of the corpuscles. The literature, however, contains no such information. Loge and Shapleigh (15), using the technique of differential agglutination, have measured the survival of red cells from healthy young adults after transfusion into 5 recipients, 72 to 83 years of age. Fifty per cent of the transfused cells survived for 64 to 73 days; the total survival time varied from 128 to 145 days, with an average of 136 days. No conclusions can be drawn from these 5 observations, but the results do suggest that red cell survival time in elderly people may be slightly greater than in young adults.

Information about the red blood cell in subjects 60 or more years of age may be summarized as follows: there seems to be a slight but significant decrease in the erythrocyte, hemoglobin, and packed red cell values from levels found in healthy young adults. The decrease is probably more pronounced for men[1] than for women so that the sex difference becomes smaller. The over-all mean values for data included in table 1 are:

[1] This change may be secondary, in part at least, to the decreased testosterone secretion in elderly males. The subject has recently been reviewed by Hamilton (Hamilton, J. R., Role of Testicular Secretions as indicated by Effects of Castration in Man) and by Studies of Pathological Conditions and Short Life Span Associated with Maleness. (*Recent Progr. Hormone Research, 3:* 257-322, 1948).

TABLE 2. MEAN VALUES FOR 100 HEALTHY OLD PEOPLE.

| Sex | Age | RBC (Millions) | Hb. (Gms.) | Hematocrit (%) | WBC ($mm^3$) | Platelets ($mm^3$) |
|---|---|---|---|---|---|---|
| 50 Males | 60–94 | 4.75±0.57 | 14.1±1.53 | 42.1±3.98 | 7,730±2,170 | 732,000±299,000 |
| 50 Females | 60–90 | 4.71±0.46 | 13.7±1.07 | 40.8±2.89 | 6,497±1,490 | 781,000±331,000 |

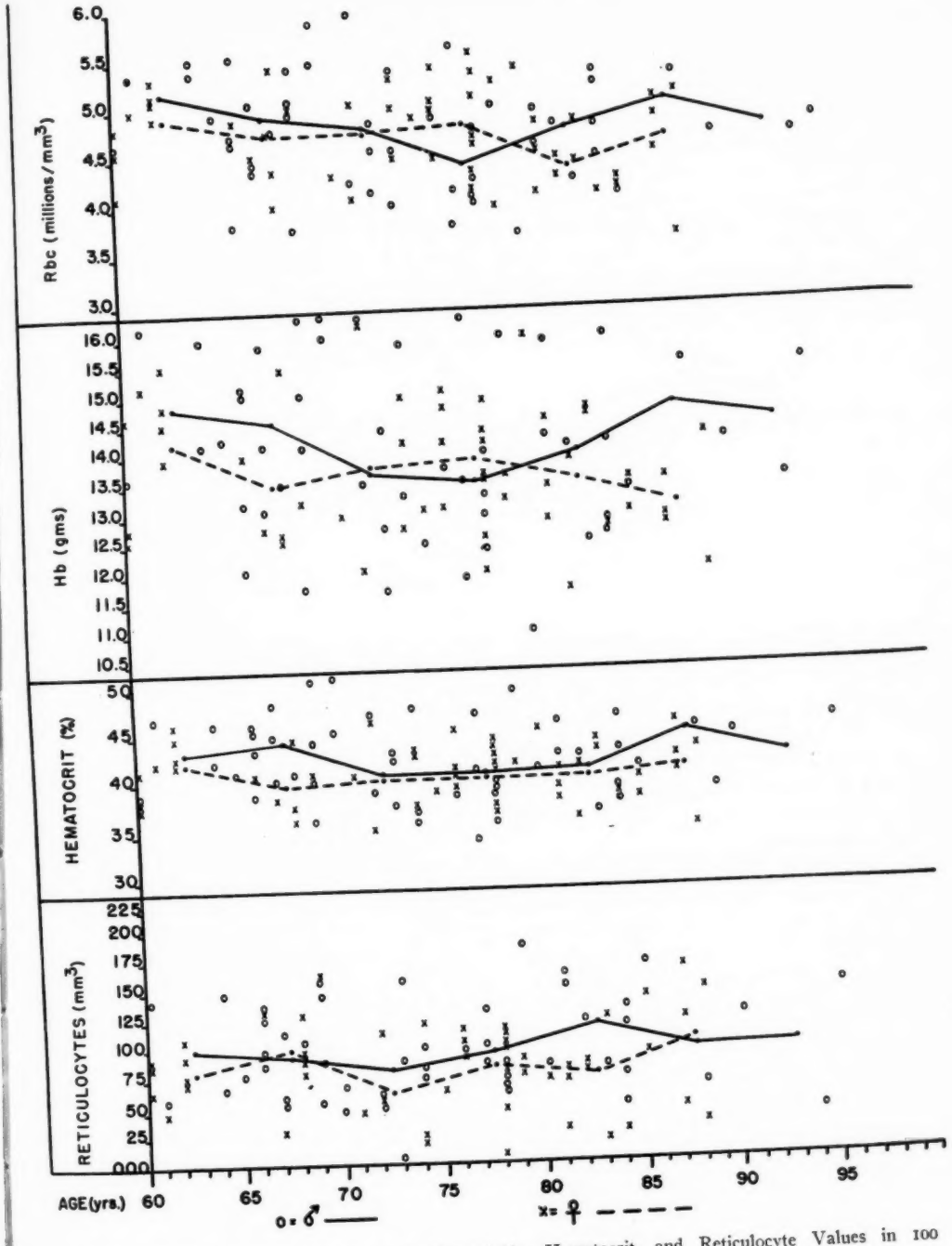


FIG. 2. Scatter Diagram of Erythrocyte, Hemoglobin, Hematocrit, and Reticulocyte Values in 100 Healthy Old People.

| | RBC | Hb. | Packed Cell Vol. |
|---|---|---|---|
| Men | 4.73 millions/mm³ | 14.09 gm. Hb./100cc. | 43.69% |
| Women | 4.58 millions/mm³ | 13.47 gm. Hb./100cc. | 40.46% |

Reticulocyte counts are unchanged. There is no further consistent tendency for any of these values to increase or decrease as age advances. The corpuscular constants are probably not altered, although the mean corpuscular hemoglobin concentration may possibly be a little lower. Qualitative changes in the erythrocyte are minimal if they occur at all.

### Leucocyte Values

The principal studies reported in the literature on the total number and distribution of white blood cells in the aged are summarized in table 3. Included again for comparison are the values proposed as normal by Wintrobe (33) and Osgood (23). Minimum and maximum levels for the total number of white cells extend over the wide range of 2,000 to 16,000 cells per mm³. In the present series of 100 cases the means and the standard deviations were: 7,730 ± 2,170 cells per mm³ for males and 6,497 ± 1,490 for females (table 2). The averages of all figures were 7,145 cells per mm³ for men and 6,982 cells per mm³ for women. There is, therefore, no significant deviation from the levels found in healthy young adults.

The differential leucocyte counts likewise show no consistent change from the normal. In 5 studies (6, 9, 11, 20, 21), the mean values for segmented neutrophils were higher than those given by Wintrobe and Osgood. Dotti (7), on the other hand, reported an increase in lymphocytes with a decrease in neutrophils and monocytes. The higher monocyte levels found by the authors may be explained by the fact that differential counts were made on supravital preparations which frequently yield higher percentages of monocytes than are usually reported on fixed, Wright-stained films.

Figure 3 is a scatter diagram of the total white blood cells, polymorphonuclear neutrophils, lymphocytes, and monocytes per mm³ in the 100 subjects studied, plotted against age. No significant increase or decrease occurred in these cells with advancing age.

No constant morphologic alterations have been observed in the leucocytes of elderly people. Olbrich (21), however, described increased lobulation of the nuclei of neutrophils with a concomitant decrease in granulation. Dobrovici (6) also believed that, in general, the cells are more mature. The remaining investigators regarded leucocytes as being morphologically normal.

### Factors Related to Hemostasis

Almost no data are available concerning the hemostatic mechanism in the aged. Puxeddu (25) found the total platelet counts decreased in 94 subjects 60 to 90 years of age. Using 200,000 to 300,000/mm³ as normal, he obtained a maximum of 198,680/mm³ in males with a minimum of 54,893/mm³. In females, the maximum was 175,600/mm³ and the minimum was 70,266/mm³. Our results are not in agreement with this observation. Table 4 shows that the present 100 subjects investigated had platelet counts well within, and in many cases above, the normal values for the method used (Dameshek, 400,000-800,000 per mm³). Only a few subjects were found to have counts below the accepted normal minimum.

No studies made on people of advanced age have recorded bleeding times, clotting times, prothrombin levels or determinations of other components of the hemostatic mechanism. However, there is no evidence that hemorrhagic disorders, when seen in old persons, are related directly to the process of aging. The only exception to this might be the so-called senile purpura which is due to an increase in vascular fragility secondary to the atropic changes that occur in the skin and subcutaneous tissues with age.

### Sedimentation Rate

The erythrocyte sedimentation rate is widely used as a nonspecific test which helps to establish the presence or absence of organic disease.

Table 3. Leucocyte Values.

TABLE 3. LEUCOCYTE VALUES.

| Author | Age Range | Sex and Number of Cases | Max. | Total WBC ($mm^3$) Min. | Mean | Basophils % | Eosinophils % | Myelocytes % | Meta-myelocytes % | Stabs % | Segs % | Lympho-cytes % | Mono-cytes % | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Normal Values—Young Adults* | | | | | | | | | | | | | | |
| 1. Wintrobe, (33) | Young Adults | M.<br>F. | 10,000 | 5000 | 7000 | 0–0.75 | 1–3 | 0 | .. | 3–5 | 54–62 | 25–33 | 3–7 | |
| 2. Osgood, (23) | 14–30+ | M. } (Variable, No. of cases, never less than 236)<br>F. } | 11,500 | 4500 | 7400 | 0–2<br>Mean 0.5 | 0–6<br>Mean 1.9 | .. | .. | 0–5<br>Mean 0.8 | 33–78<br>Mean 54 | 18–65<br>Mean 38 | 0–9<br>Mean 4 | |
| *Normal Values in the Aged* | | | | | | | | | | | | | | |
| 1. Olbrich (21) | 61–88 | M. 41<br><br>F. 48 | 9,000<br><br>12,800 | 4600<br><br>3200 | 7020<br><br>7058 | 0.0–3.0<br>Mean 0.5<br>0.0–4.0<br>Mean 0.6 | 0.0–7.0<br>Mean 2.3<br>0.0–8.0<br>Mean 1.9 | 0<br><br>0–1 | ..<br><br>.. | 0.0–1.0<br>Mean 0.04<br>0.0–1.0<br>Mean 0.1 | Mean 71.8<br><br>Mean 67.8 | 10–46<br>Mean 22.9<br>12–45<br>Mean 27.0 | 0–8<br>Mean 2.3<br>0–8.6<br>Mean 1.8 | Tendency to increased lobulation and decreased granulation of WBC. No total segmented form values given; divided into number of lobes. |
| 2. Etienne & Perrin (9) | 80–96 | M. 20<br>F. 7 | 12,800<br>9,200 | 5600<br>5600 | 8680<br>7371 | 1–2.5 | 1–2.5<br>Mean 1.75 | .. | .. | .. | 57–74<br>Mean 67.1 | 18–36<br>Mean 24.85 | 1–8.5<br>Mean 5.1 | Morphology essentially normal. No sex differences in differential. |
| 3. Newman & Gitlow (20) | 65–104 | M. 50<br>F. 50 | 12,050<br>11,100 | 5000<br>5050 | 8330<br>8170 | *0.3–1.0<br>0.0–0.5 | *0.6–3.5<br>1.0–2.0 | ..<br>.. | *0–0.3<br>0–1.0 | Mean 5.1<br>Mean 4.2 | Mean 60.2<br>Mean 63.0 | Mean 33.5<br>Mean 33.8 | *0.7–2.0<br>1.0–2.1 | *Range of averages of 5 year age increments from 65 to 94 years. |
| 4. Miller (17) | 60–104 | M. 160<br>F. none | 13,000 | 4000 | 7700 | 0–2.0<br>Mean 0.7 | 0–8.0<br>Mean 2.7 | .. | .. | .. | 40–75<br>Mean 57.5 | 15–50<br>Mean 30 | 1–15<br>Mean 7.8 | WBC essentially the same as in younger age groups. |
| 5. Gabbert, Hutaff, Harrell (12) | >70 | .. | 16,000 | 2000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | Total WBC same in aged as in young adults. |
| 6. Fowler, Stephens, Stump (11) | 65–80 | M. 73<br>F. 27 | 12,450 | 2900 | 7220 | 0–3<br>Mean <1 | 0–10<br>Mean 2.8 | .. | .. | 1–13<br>Mean 4 | 43–79<br>Mean 60.2 | 11–48<br>Mean 27.5 | 1–15<br>Mean 5.4 | Total WBC and differential normal. |
| 7. Dobrovici, (6) | 67–81 | M. 11<br><br>F. none | ..<br><br>.. | ..<br><br>.. | ..<br><br>.. | ..<br><br>.. | 1.0–1.5<br>Mean 1.2<br>..<br>.. | ..<br><br>.. | ..<br><br>.. | ..<br><br>.. | 64.5–80.5<br>Mean 73<br>..<br>.. | 13.5–30.0<br>Mean 20.4<br>..<br>.. | 3–9.5<br>Mean 5.4<br>..<br>.. | Tendency to more mature cells in aged. |
| 8. Dotti, (7) | 60–92 | M. 26<br><br>F. 35 | 8,602<br><br>7450 | 4948<br><br>4000 | 7039<br><br>5795 | 0–3.5<br>Mean 0.8<br>0–1.5<br>Mean 0.3 | 2.2–17<br>Mean 4.6<br>0.5–5<br>Mean 2.2 | ..<br><br>.. | ..<br><br>.. | ..<br><br>.. | 30.5–67.4<br>Mean 52.4<br>28.3–70.5<br>Mean 55.6 | 21–65<br>Mean 37.9<br>22–54.4<br>Mean 36.7 | 1–9.5<br>Mean 3.3<br>2.6–8.3<br>Mean 5.2 | Total WBC normal, with increase in lymphs., decrease in monocytes and segmented forms. |
| 9. Shapleigh, Mayes, Moore | 60–95 | M. 50<br><br>F. 50 | 16,000<br><br>10,350 | 4250<br><br>3150 | 7730<br><br>6497 | 0–4<br>Mean 1.1<br>0–3.0<br>Mean 1.0 | 0–9<br>Mean 4.4<br>0–17<br>Mean 4.7 | 0–1<br><br>0–2 | 0–1<br><br>0–1 | 0–5<br>Mean 1.4<br>0–8<br>Mean 1.5 | 28–86<br>Mean 59.1<br>28–75<br>Mean 55.6 | 4–46<br>Mean 23.5<br>11–62<br>Mean 27.7 | 4–26<br>Mean 10.4<br>2–19<br>Mean 9.1 | Morphology normal. |
| | | Average Values | | | | M. (347)<br>F. (190) | 7145<br>6982 | | | | | | | |

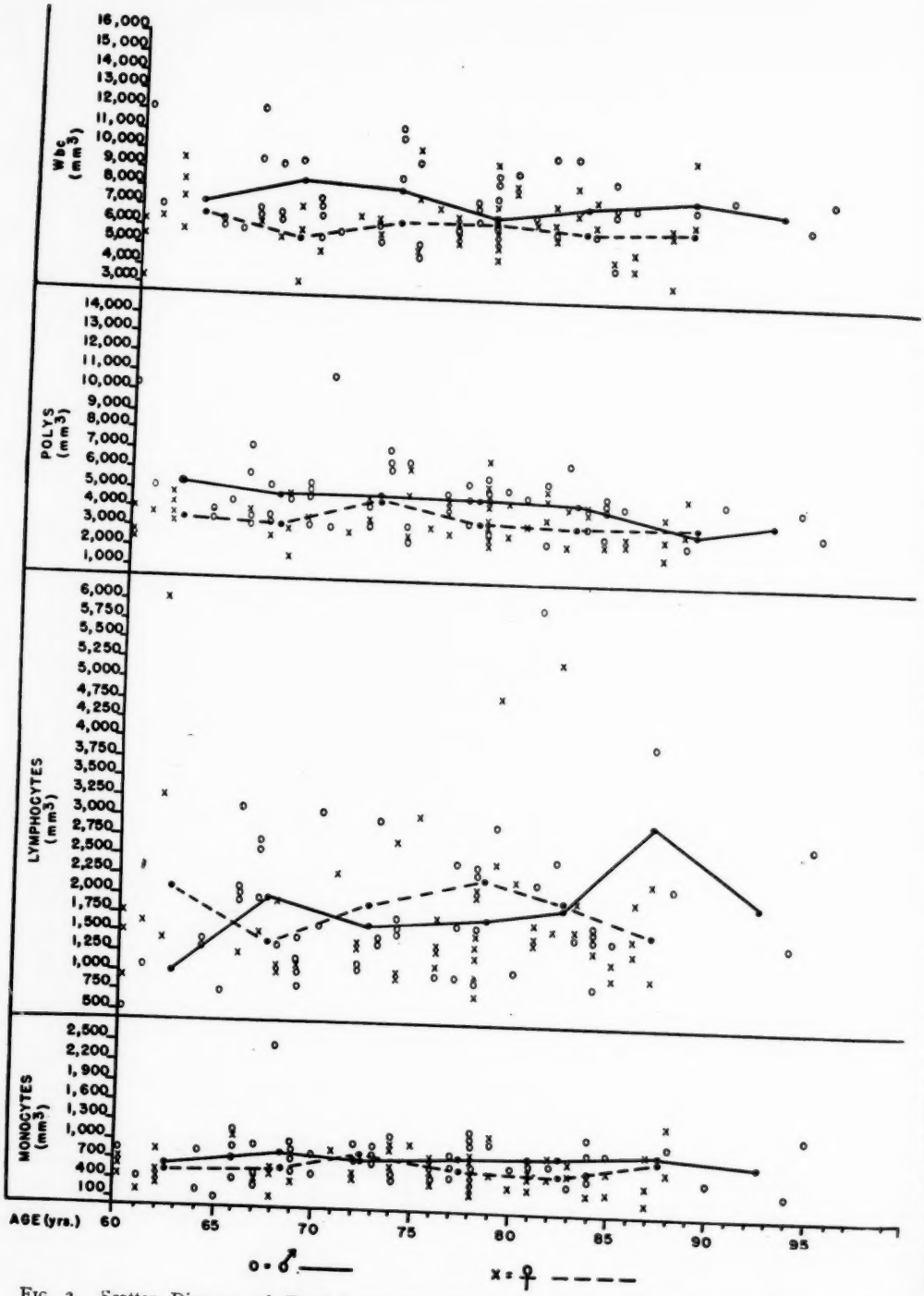


FIG. 3. Scatter Diagram of Total Leucocyte, Polymorphonuclear Neutrophil, Lymphocyte, and Monocyte Values in 100 Healthy Old People.

It is important, therefore, to know if the sedimentation rate increases with advancing age in the absence of any pathologic changes other than those associated with the aging process. Miller (16) studied the sedimentation rate of 389 male subjects over 60 years of age. Using a 10 per cent drop in sixty minutes as the upper limits of normal, he found that 245, or 63 per cent, of his subjects fell within the normal range, 80, or 20 per cent, showed a fall of 11 to 20 per cent, and the remaining 64 had rates that varied from 21 to 70 per cent fall. He concluded that age has little if any effect on the suspension stability of erythrocytes.

Eckerström (8) measured the sedimentation rate in 100 men and 100 women 70 years of age or older. The average rate was 6.3 mm. in men and 10.4 mm. in women, values which are approximately the same as were obtained with the same method in young, healthy people. Olbrich (22), on the other hand, using the Westergren method in a study of 78 subjects, reported a definite increase in the sedimentation rate with advancing age. His values varied from 2 to 37 mm. per hour for males and from 2 to 27 mm. for females; average rates were 12.1 and 11.7, respectively.

The results obtained by the present authors on their 100 subjects are summarized in table 5. The limits of normal used for the Wintrobe method after correction for hematocrit were: less than 11 mm./hr. for males and less than 19 mm./hr. for females. For only 4 of the men and 8 of the women did the values fall within this range. Twenty of the men (40 per cent) and 30 of the women (60 per cent) had rates faster than 30 mm/hr. The data on the sedimentation rate in people of advanced age, therefore, are conflicting. Any conclusions must be postponed until further information is available.

## Summary

The review made here emphasizes the incomplete and inadequate state of our knowledge about the hematologic system in the aged. About the only statement one can make with assurance is that the peripheral blood and bone marrow do not change strikingly as people grow older. The total volume of red, hematopoietically active marrow probably decreases, but the amount which remains is able to maintain erythrocyte values at levels only slightly lower than those found in young adults. Counts

Table 4. Total Platelet Counts (per mm³) in 100 Healthy Aged Subjects.

| Sex | Total Cases | No. Showing <400,000/mm³ | No. Showing 400,000–800,000/mm³ | No. Showing >800,000/mm³ |
|---|---|---|---|---|
| Male | 50 | 10 | 21 | 19 |
| Female | 50 | 6 | 24 | 20 |
| | | Maximum per mm³ | Minimum per mm³ | Mean per mm³ |
| Male | 50 | 1,392,000 | 255,000 | 732,000 |
| Female | 50 | 1,430,000 | 330,000 | 781,000 |

Table 5. Sedimentation Rates (mm. per hr.) in 100 Healthy Subjects.

| Sex | Total Cases | No. Showing 0–10 | No. Showing 11–20 | No. Showing 21–30 | No. Showing 31–40 | No. Showing >40 |
|---|---|---|---|---|---|---|
| Male | 50 | 4 | 13 | 13 | 11 | 9 |
| Female | 50 | 3 | 5 | 12 | 14 | 16 |

in men remain slightly higher than in women, but sex difference in the average values becomes less. No consistent change has been found in the total number of white blood cells, the percentage of the several types of leucocytes, or the platelet count. Even these generalizations, however, are based on meager data and may need revision after more extensive studies have been completed.

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# Extensive Aneurysms of the Abdominal Aorta, Common Iliac, and Hypogastric Arteries

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Unusual aneurysms of the lower abdominal aorta and its branches have been revealed in the course of a recent anatomic dissection. In more than 500 cadavers examined in this laboratory only one similar vascular involvement was observed—a case of bilateral aneurysms of the common iliac arteries (2).

The present report is based on findings in the cadaver of an emaciated white female, 5 feet 6 inches in height, aged 84 years. Clinical history preceding that of a few days before death was unobtainable.

## Description of the Aneurysms

Dissection of the abdomen revealed large retroperitoneal masses extending from the level of the second lumbar vertebra, over the sacral promontory, and into the major pelvis. Following removal of the viscera and reflection of the peritoneum five distinct masses were observed. The largest of these was continuous with the distal portion of the abdominal aorta from the level of the second lumbar vertebra to the bifurcation of the vessel. The sacculation of this mass extended laterally beyond the bodies of the vertebrae on the left side and over the inferior vena cava on the right (see fig. 1). The inferior mesenteric artery arose from the ventral aspect of the aneurysm and was completely occluded; the lumen of the middle sacral artery was obliterated at its origin from the aorta, and extensive collateral circulation was observed.

The aneurysm in the right common iliac

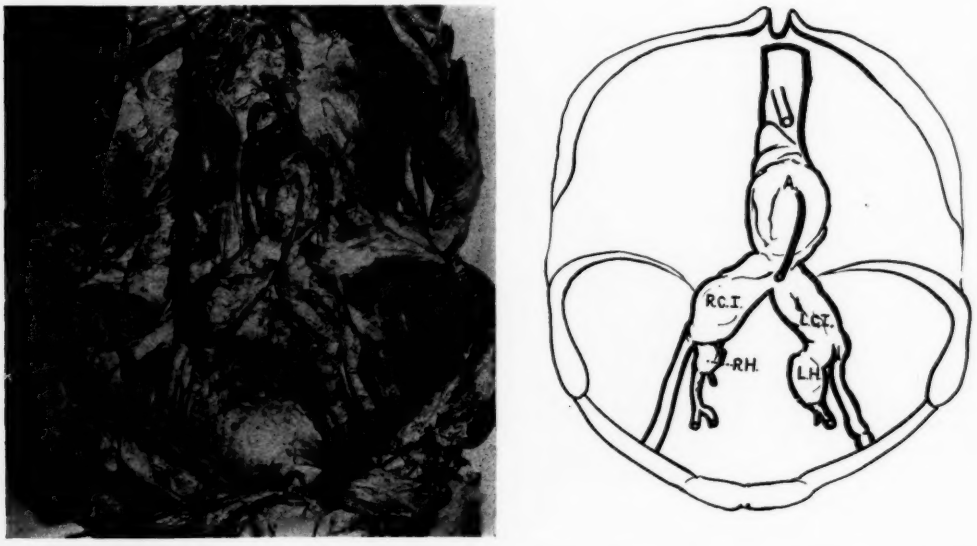


Fig. 1. Photograph (X 1/3 showing aneurysms within the abdominal cavity and major pelvis (the peritoneum and surrounding viscera have been removed); and, drawing showing outlines of aneurysms. A, abdominal aorta; R.C.I., right common iliac artery; L.C.I., left common iliac artery; R.H., right hypogastric artery; L.H., left hypogastric artery.

artery extended proximally to within 2.5 cm. of the origin of the vessel; that in the left common iliac to within 2.8 cm. of the aortic bifurcation. Both of these aneurysms extended distally as far as the bifurcation of the common iliac arteries.

The aneurysm in the right hypogastric artery was small and continuous with that in the common iliac, whereas that in the left hypogastric was larger and quite discrete. Dimensions of the aneurysms are listed in table 1.

By means of a longitudinal incision in the wall of each sacculation, the consolidated deposits were removed (see fig. 2). Examination showed each to be of the same type, grossly an irregular, rough mass consisting of blood clot and cholesterol forming a firm, hard structure. Longitudinally piercing each mass was the patent lumen of the original vessel, apparently unaltered in size, lined by intima, and containing loose dried clots of blood. Histologic sections of the vessel walls showed widespread destruction of the media with elastic tissue almost absent and fibrous connective tissue comprising most of the remaining thickness of the vessel walls. In addition, the vessel walls were observed to contain generalized calcium deposits, with no evidence of syphilitic lesions; rather, the general evidences of arteriosclerosis were further confirmed. A definite increase in size of the vasa vasorum was noted.

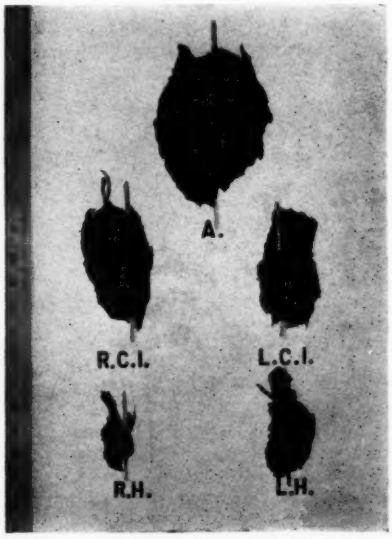


FIG. 2. Masses removed from the blood vessel walls by means of lateral incisions at the sites of the aneurysms. A probe extends through the lumen of each mass. Letters correspond to those in figure 1.

### CLINICAL HISTORY

The patient was admitted to St. Louis County Hospital in a semi-conscious critical condition on December 24, 1949. Her hospital record indicated that she was unmarried, had no living relatives, and had lived with friends for three years preceding the admission date. No additional facts were obtainable.

Upon admission she appeared to be poorly nourished, poorly developed, and did not respond to verbal stimuli. Examination revealed distant breath sounds and the heart was extended to the left with a grade II precordial systolic murmur. The abdomen was found to be soft and scaphoid and there were no palpable masses. The skin was loose, cold, and dry, with beginning ulceration over the sacrum and buttocks. Temperature was 96, pulse 70, respiration 16, and blood pressure 130/80. No Kahn test was recorded. A diagnosis was made of dehydration, malnutrition, general arteriosclerosis, senile dementia, and right encephalopathy. Treatment was begun with administration of parenteral fluids, but the patient's course progressively deteriorated to expiration on December 25.

TABLE 1. DIMENSIONS OF THE ANEURYSMS (IN CENTIMETERS).

| | Abdominal Aorta | Right Common Iliac | Left Common Iliac | Right Hypogastric | Left Hypogastric |
|---|---|---|---|---|---|
| Circumference | 14.0 | 9.0 | 8.1 | 4.7 | 7.3 |
| Transverse Diameter | 5.5 | 3.4 | 3.1 | 1.5 | 2.4 |
| Antero-posterior Diameter | 3.6 | 3.6 | 2.1 | 1.5 | 1.6 |
| Length | 8.8 | 5.0 | 4.4 | 2.5 | 4.8 |

*Post mortem.* Primary cause of death was recorded as arteriosclerotic heart disease, malnutrition, and dehydration. Dissection revealed massive calcium plaques along the inner walls of the aorta in its proximal portions, a bulging in the aorta at the level of the eighth thoracic vertebra, great enlargement and calcification of the popliteal arteries, a patent left superior vena cava, an aberrant vertebral artery, pleural adhesions, and the aneurysms listed above.

## Discussion

A search of the literature has revealed no other case of aneurysms as extensive in these locations. Aneurysms of the common iliac arteries are believed to be quite rare; Garland (3) found only one case of common iliac aneurysm out of 178 aneurysms in 12,000 autopsies and this was not bilateral.

Dissecting aneurysms of the abdominal aorta are relatively more common; Scott (6), reporting on 96 cases of abdominal aneurysm, listed the etiology as follows: syphilis, 58.3 per cent; arteriosclerosis, 20.0 per cent; mycotic, 18.8 per cent; and miscellaneous causes, 3.0 per cent. He pointed out, however, that while syphilis is the major cause of aneurysms of the upper abdominal aorta and of the aneurysms arising at the origin of the major upper branches, aneurysms of the more distal portion of the aorta and its branches are rarely syphilitic in origin. Scott further states that 30 per cent of arteriosclerotic aneurysms are multiple in nature.

Glendy, Castleman, and White (4), reporting on several cases of dissecting aneurysms of the aorta, cite at least three instances in which the pathology occurred originally in the proximal portion of the aorta and later extended into its branches including the common iliacs. Schlichter (5) points out the obliteration of the vasa vasorum as a primary factor in the etiology of dissecting aneurysm. Eliason and McNamee (1) indicate that aneurysms occurring in a patient over 80 years of age are uncommon.

In view of the cause of death and, in addition, the gross and histologic evidences from the vessel walls, these aneurysms may be described as arteriosclerotic in origin and dissecting in type. On the basis of Scott's classification, the aneurysm within the abdominal aorta itself may be designated as "large" (over 5 cm. in diameter).

## Summary

A case of extensive aneurysms of the abdominal aorta and its branches in an 84 year old woman is reported. The principal etiologic factor was arteriosclerosis.

The authors wish to express their appreciation to Dr. Mildred Trotter under whose direction this report was made.

Student dissections were carried out under careful staff supervision.

The authors wish to thank Dr. Curtis H. Lohr, Superintendent, St. Louis County Hospital, for making the hospital records available.

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# The Risk of Urologic Surgery in Men Past 80

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THE surgical care of elderly men has been discussed many times (1, 2, 3). It is a topic which will continue to be of interest to all physicians. Everyone will agree that chronologic age is of less importance than physiologic age. Many men are older at 60 years of age than others at 80 years. Degenerative disease often takes its toll in some unfortunate men even before the age of 60 years. While it might be said with some truth that a man who lives to the age of 80 years must be rather vigorous, it is nevertheless a fact that men at this point in life as a group present far greater surgical risks than those younger.

Several articles recently have appeared quoting mortality data following general surgical procedures. These pointed out that in spite of the best of care, including the use of all the antibiotics, and the wisest selection of anesthetics, death occurs postoperatively five times as often or more than in young men. A review of a group of men beyond their eightieth birthday who underwent urologic surgical procedures will be presented.

Habein and I (5) have pointed out that the preoperative examination and care of elderly men is equally as important as operative technic, if not more important; also, that in addition to a wise choice of anesthesia certain important aspects of postoperative care must not be forgotten.

I have selected for this review the case histories of all the men beyond the age of 80 years who were operated on for urologic diseases at the Mayo Clinic during the years 1941 to 1950 inclusive. As might be expected, the large majority of these suffered with a prostatic disorder. Of the 654 patients encountered 615 were operated on for a benign or malignant enlargement of the prostate gland, and 39 underwent surgical procedures for disease of the genito-urinary tract other than that of prostatic origin.

The age of the patients is shown in table 1, as well as the mortality rate, grouped according to half decades. The small number of patients beyond the age of 90 years probably prevents estimation of real mortality expectancy at that age level. For the group as a whole the mortality rate is 4.1 per cent.

TABLE 1. AGE OF PATIENTS AND HOSPITAL MORTALITY.

| Age, Years | Patients | Hospital Deaths | |
|---|---|---|---|
| | | Number | Percentage |
| 80-84 | 493 | 16 | 3.2 |
| 85-89 | 138 | 11 | 8.0 |
| 90-94 | 22 | 0 | ... |
| 95+ | 1 | 0 | ... |
| Total | 654 | 27 | 4.1 |

## PREOPERATIVE EXAMINATION

A rather complete survey of the patient is indicated, including urinalysis, roentgenograms of the chest and of the area of the kidneys, ureters, and bladder, blood counts, serologic tests, blood grouping, Rh determination, and electrocardiogram. With these as a basic minimum, other studies, such as roentgenographic examination of the stomach, gallbladder, and colon, proctoscopic examination, special blood examinations such as estimation of the alkaline and acid phosphatase levels, and any of the numerous other laboratory procedures, might be done if indicated.

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However, it must not be forgotten that much information can be obtained concerning an elderly man by physical examination alone. On physical examination it is well to watch for shortness of breath on exertion, pitting of the ankles, the degree of sclerosis and tortuosity of the radial arteries and the response to ordinary questioning. A man who is alert, replies quickly, and is keen mentally is usually a better risk than one who is sluggish in his physical and emotional reactions. The texture of the skin and the clearness of the eyes, the strength of his grip and response to his surroundings are important things to note. A patient who is obviously interested in the details of his examination and who is reasonably alert is a better risk than the querulous, arteriosclerotic, sluggish individual. These are but a few of the things which determine physiologic age. I would much rather depend on physical signs than on laboratory data when making a final decision as to whether or not a man is a suitable risk for operation. One must not depend on the hospital chart for this decision.

One can expect to find in men beyond the age of 80 years a considerable amount of degenerative disease of other organs. In the review which Habein and I made we found hypertension, generalized arteriosclerosis of advanced degree, coronary sclerosis with a history of angina pectoris, and significant electrocardiographic changes in more than half of a group of 300 cases studied very carefully. Senility, weakness, diabetes, Parkinson's disease, and a recent cerebrovascular accident were other conditions which often contributed to the risk of operation.

If one then adds to these other things the added strain of fever of urinary tract origin and finally renal insufficiency, the hazard to life is indeed great. Too many elderly men are allowed to deteriorate in this manner, surgical treatment being postponed or avoided entirely, because of ignorance on the part of their physicians of the comparatively low risk of operation. I have seen men who were allowed to suffer with overflow incontinence, fever and chills, severe hematuria, and prolonged episodes of uremia while temporizing measures such as intermittent catheterization, inadequate chemotherapy, and failure to use supportive parenteral fluid supplement let the patient slip from bad to worse and finally into a desperate condition. It is not difficult as a rule to keep an inlying catheter of small caliber in place, and it will usually control fever and allow for an adequate fluid intake, whereas lack of the inlying catheter usually results in restriction of fluid intake so that intermittent catherization can be done as infrequently as possible. In their senile state many of these men will themselves restrict their intake of fluids so drastically that they become obviously dehydrated. Renal function inevitably becomes poor on such a regimen.

## Preoperative Therapy

When the examination has been completed it is necessary sometimes to make a decision in spite of urologic disease to postpone surgical treatment of the urinary condition until after some more important therapy has been instituted. For instance, examination might reveal a marked anemia due to a gastric or intestinal malignant lesion. This will require resection prior to the urologic surgical procedure, but meanwhile an inlying catheter if it is properly cared for will obviate any complication. I have seen a number of cases of this type in which the patients were men beyond the age of 80 years.

When cardiac conditions complicate the picture, operation might be delayed until the patient's heart is compensated. A recent cerebrovascular accident justifies delay of at least several weeks. A severe anemia usually prompts one to give a series of blood transfusions while the cause of the anemia is being established. Such patients must not be kept in bed except on the day of operation. Getting them up will stimulate them, prevent stasis in their blood vessels and bowels, and keep them interested in surviving.

Sedative drugs and opiates must be used sparingly in comparison to their use for men

in their early, more vigorous decades of life. Particularly is this true as regards the preoperative use of pentobarbital sodium and morphine. On a number of occasions I have had to postpone an elective operation because the patient was quite prostrated by ordinary routine preanesthetic medication. This point has been stressed by others (6).

### Anesthesia

The choice of an anesthetic agent is more important in the aged than in any other type of patient (4). Inhalation anesthesia must be avoided as a rule. In my experience the safest agent to give is intraspinal procaine hydrochloride in small doses, administered as low in the canal as possible. Injection of 50 mg. of procaine hydrochloride dissolved in 1.5 cc. of spinal fluid into the fourth lumbar interspace will often provide excellent anesthesia for more than an hour. All sensation will be abolished high enough to enable one to do an operation on the bladder or prostate gland. Positioning the patient in order to prevent the drug from ascending higher in the spinal canal is wise. The Trendelenburg position should be avoided if possible.

If blood loss of any great amount is anticipated, it is well to place a needle in a suitable vein and start administration of saline or glucose solution at a slow rate. Meanwhile a pint or more of matched blood should be readied for use if it becomes necessary. Anticipation of trouble makes it less serious if it should arise.

If intravenous anesthesia has been chosen it should be given as lightly as possible so that the patient rouses soon after the operation is completed.

### Operation

While the speed with which an operation is performed is of secondary importance, I cannot agree with men who insist that it is possible to continue a procedure for several hours in any case providing several supportive blood transfusions are given. Experience forces the conclusion that repeated blood infusions are not well tolerated by old men, and as a matter of fact they are seldom necessary.

One very important point regarding supportive blood therapy is the insistence on determination of the Rh factor. A patient who is negative for the Rh factor will not tolerate positive blood repeatedly and probably not even once very well. I feel certain that prior to routine determination of the Rh factor I have lost patients with renal insufficiency during their postoperative course because they were negative for the Rh factor and Rh positive blood was administered.

Fortunately, most urologic procedures can be completed in much less than one hour, in fact often in half that time. Shock, therefore, is seldom encountered and the stabilized blood pressure makes it possible to avoid cardiac and cerebral anoxia. Old men generally have considerable sclerosis of their arteries and a fall in blood pressure even for a short time may be disastrous.

Transurethral resection of the prostate gland fortunately can be done rapidly in most cases and bleeding can be controlled by very accurate visual electrocoagulation of spurting vessels in practically every case. Loss of blood, therefore, should not be great. Methods of measuring the actual loss by colorimetric estimation of the hemoglobin content in the wash water which was used have been previously described. The loss can, therefore, be rather accurately computed and its replacement can be accomplished.

Transurethral resection of the prostate gland is several times as safe as any other surgical method of removal which has been employed for men beyond the age of 80 years. In fact the obstructing tissue can often be excised with less risk than is involved in the prolonged use of an inlying catheter. Urethral tenesmus, fever and chills, disorientation, loss of appetite, weakness, and exhaustion are often avoided by electing to do the operation at an early date. In this way the period of hospital confinement can be reduced to a minimum.

## Postoperative Care

Early ambulation is of greatest importance in these cases. The next thing which insures speedy recovery in my opinion is the avoidance of large doses of sedatives and opiates. A man in this age group will usually bear pain well. Often the nurse or an anxious relative will do more harm than good by insisting that the patient be kept very comfortable. A quarter of a grain of morphine added to a temperature a degree or two above normal in an arteriosclerotic man will often bring on total disorientation. In such a state I have seen injury result from the patient's falling out of bed or falling in the room while attempting to get up and move around for one reason or another. Whenever possible, special nurses should be employed during the first postoperative day or two. Side rails on the bed are a wise precaution if nurses are unavailable.

Intravenous fluids should be given slowly, and rarely more than a liter at one time. Several hours might well be required for this. The routine use of antibiotics or other antibacterial agents does not seem justified to me because I have seen a number of patients greatly prostrated owing to sensitivity to these drugs.

Fecal impaction can be obviated as a rule by early ambulation and forcing oral fluids after the first day. Encouraging the patient to breathe deeply and exercise his legs during the first postoperative day will often prevent pulmonary and vascular complications.

Prolonged hospitalization following operation should be avoided. Elderly men do far better convalescing in their home surroundings which are familiar to them. The will to live is kept active and all their physical functions are enhanced. I have seen many men who continued to fail and who I am sure would have died had they not been released to their homes for convalescence in the second or third postoperative week.

In the group of 467 patients for whom transurethral resection was done for benign hypertrophy of the prostate gland 34.7 per cent spent a week or less in the hospital following operation; an additional 45.6 per cent spent from a week to two weeks in the hospital (table 2).

Table 2. Benign Prostatic Hypertrophy, Transurethral Prostatic Resection, Postoperative Hospitalization.

| Postoperative Hospitalization, Weeks | Number | Percentage |
|---|---|---|
| 0-1 | 162 | 34.7 |
| 1-2 | 213 | 45.6 |
| 2-3 | 60 | 12.8 |
| 3-4 | 24 | 5.1 |
| 4-5 | 4 | 0.9 |
| 5+ | 4 | 0.9 |
| Total | 467 | 100.0 |

## Results of Operation

In addition to relief of urinary symptoms, which in the majority of cases is quite complete and dramatic, these octogenarians as a rule note improvement in their general health following operation. They sleep better, hence conserve their strength, have improved appetites, and often remarkable clearing of mental confusion occurs. Improvement in renal function relieves mild or advanced uremia. Secondary anemia is corrected, and a return of vigor of a remarkable degree is not unusual.

The correction of nocturnal overflow incontinence and of urinary urgency and soiling of their clothing restores their self-respect and makes them once more welcome members of the household. The operation often earns not only the gratitude of the patient but that of the entire family. The risk of transurethral resection of the prostate gland is in my opinion smaller than the risk of continued physical disability and the complications such as fever, chills, renal insufficiency, and other sequelae which inevitably result from postponing the operation.

There are, of course, postoperative complications which disrupt a smooth convalescence in a small percentage of cases. In patients of this age group they occur more frequently

than in younger men, as one might expect. If fever of an alarming degree develops, antibiotic therapy should be employed. However, as stated previously, I do not routinely employ these drugs.

In this series of 654 cases fatal complications arose in 27. The principal cause of death in each case is listed in table 3. Strangely enough these conditions usually arise in patients in whom they are least expected. In many cases patients considered prior to operation to present a very serious risk convalesced in a remarkably gratifying manner, thus justifying the procedure. Others who seemed in a much better condition, who in fact did not elicit real apprehension preoperatively, died with cardiac or pulmonary complications.

TABLE 3. DEATHS.

| Condition | Number |
|---|---|
| Cardiac disease | 7 |
| Renal failure | 6 |
| Pneumonia | 6 |
| Pulmonary embolism | 4 |
| Shock | 3 |
| Cerebral accident | 1 |
| Total | 27 |

## SUMMARY AND CONCLUSIONS

1. Extremely old men with disease of the urinary tract are better risks for surgical procedures than is commonly appreciated.

2. Severe illness and death can often be avoided or postponed by electing to do an operation rather than carrying on with temporizing measures which in themselves often involve a high risk.

3. Careful preoperative examination and preparation for surgery should be done in every case. By appropriate nursing care and thorough medical attention the condition of the patient can usually be improved sufficiently to justify operation even in those extremely ill. Collaboration of the internist and the urologist is very desirable.

4. Cautious use of preoperative sedatives and opiates and a selection of the proper anesthetic agent and its careful administration are essential to a successful result.

5. In elderly men the duration of the operation should be short, shock should be avoided, and alert postoperative management should be especially striven for in order to avoid complications. Replacement of blood loss and prompt use of antibiotics when indicated are of paramount importance.

6. The mortality rate in this series of 654 patients, all of whom were beyond their eightieth birthday, was 4.1 per cent.

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SECTION OF UROLOGY

MAYO CLINIC

ROCHESTER, MINNESOTA

# An Evaluation of Psychologic Effects of Sex Hormone Administration in Aged Women

## I. Results of Therapy After Six Months

BETTYE McDONALD CALDWELL AND ROBERT I. WATSON

ALTHOUGH the female sex hormones have been widely used for many years in the treatment of ovarian deficiency before and during the menopause, little study has been made of their effect on aged women many years past the menopause. In an earlier investigation, Masters and Allen (2) reported certain well-defined changes in the endometrium of the uterus in a group of elderly women as a result of stimulation by either estrogen alone or estrogen plus progesterone. They found that uterine bleeding could be induced under the influence of an adequate amount of replacement therapy. Despite the atrophy of the ovary, the remainder of the reproductive tract was able to respond to the female sex hormones in much the same fashion as it does in the younger woman during the years of normal ovarian activity.

Such dramatic findings would have limited scope were there no benefits to the organism as a whole or were there deleterious effects resulting from prolonged use of the hormones. With respect to the latter, it seemed apparent that none of the patients was harmed by the therapy. Carcinoma of the breast or uterus did not appear, nor was there any unusual or severe discomfort reported from the resumption of menstrual bleeding. In general, it could be said that the patients remained healthy and well. Furthermore, striking behavioral changes in the patients were observed by several members of the staff who had contact with them. They seemed to have an improved sense of well-being and vigor, more initiative, energy, and social responsiveness. Also they seemed more alert and interested in their environment and showed possible improvement in memory and other intellectual functions.

These impressions suggested the advisability of setting up an experimental program which would use some outside criterion to evaluate objectively a new group of female subjects in these areas of functioning. Performance on certain psychologic tests was the criterion chosen. This was not the only purpose of the study, as many physiologic measures were also made; however, only this one aspect will be discussed here.

### RESEARCH DESIGN

The general design of this study involved an initial psychologic evaluation as a means of establishing a base line of the abilities and attitudes of the subjects, following which half of them received regular hormone injections and half served as controls. After six months, one year, and eighteen months of therapy the two groups were retested to compare their subsequent functioning. The present report is based on the results of therapy after six months.

*Subjects.* Thirty female patients, aged 54 to 88, mean age 75.17 at the beginning of the study, were selected from a city home for the aged on the basis of certain gynecologic and psychologic criteria. Briefly, requirements by the gynecology consultants were that the patients should have intact uterus and ovaries, be relatively amenable to endometrial biopsy, and show no evidence of a neoplasm. As the design of the experiment was not predicated upon any particular type of subject from the psychologic point of view, variation was permitted with the exception that the patients should be able to see, hear, and talk well enough to communicate with the psychologist to a prescribed minimum degree.

After the administration of a battery of 10 psychologic tests, the subjects were divided

equally into experimental and control groups. Age, amount of education, and intellectual level were considered relevant in the matching.

Every attempt was made to preserve the anonymity of the two groups. Only the physician preparing the injections and the coordinator of the entire project knew their identity conclusively. Attendants, nurses, and patients were not aware that there were two distinct subgroups. Because of the fact that the bleeding itself would introduce an undeniable distinction, the patients and attendants were given the explanation that the injections sometimes resulted in bleeding and sometimes did not. They were assured that the bleeding would not herald the presence of any disease.

*Endocrinologic Procedure.* The experimental subjects were first stimulated intramuscularly with 1 mg. of estradiol benzoate three times per week for six weeks, at which time the medication was withdrawn for one week. Previous experiments (2, 3) have shown that basic estrogen stimulation is necessary for successful regeneration of the corpus uteri prior to undertaking controlled withdrawal bleeding. The basic estrogen stimulation was continued for three more weeks, following which it was again withdrawn for one week. At this point the basic dosage of estradiol benzoate was reduced to 2 mg. per week. This was found to be a sufficient maintenance dosage after the eleven weeks of greater stimulation. Progesterone was now given as a means of inducing bleeding.

The exact combination of estrogen and progesterone which is most effective in producing uterine bleeding cannot always be predetermined. Because of this the amount (5 mg. to 10 mg.) and duration (one day to three days) of progesterone treatment given each month was varied during the second twelve weeks of the study. It is primarily in response to the estrogen that psychologic changes are believed to occur, and this was uniform and constant for all patients.

The subjects who served as controls were given injections of sesame oil at the same time the experimental subjects received their injections of the hormones.

As this paper is concerned only with psychologic changes associated with the therapy, further information regarding the underlying physiologic process is not given. However, details of the endocrinologic aspects of the study will be presented in other reports.

*Psychologic Test Procedure.* Many practical factors such as reduced sensory and motor proficiency among subjects in the present study imposed many restrictions in the selection of the test battery. With these limitations in mind, the field of published tests was surveyed to find appropriate instruments to measure the following areas: general intelligence, memory, energy level, degree of optimism or pessimism, initiative, flexibility of thought processes, environmental interests and activities, and motivation. When published tests could not be found which seemed suitable for this age group, new instruments designed specifically for the study were used.

Most of the instruments included in the battery are familiar to the reader with psychologic training. However, for the benefit of those whose experience has not been so oriented, a brief description of each test will be given prior to the presentation of results from the instrument.

## Results

The design of this experiment calls for a comparison of the scores made by each group on the first test with their scores made at the time of the second examination, plus a cross comparison of the difference between the gains or losses shown by the two groups. That is, for each variable considered relevant, an analysis was made not only of the test-retest change within each group but also of the difference between the mean gains or losses shown by the two groups. Thus, if $D_e$ is the difference between the pre- and post-test scores in the experimental group and $D_c$ the equivalent difference in the control group, the statistical significance of each of these shifts was evaluated as well as $D_e - D_c$, or the difference be-

tween the changes shown by the two groups. The latter analysis provides an additional check on whether any gains shown by the experimental group can be attributed to the interpolated experience (sex hormone administration) or whether they may be explained in terms of practice effects or greater familiarity with the examination process. The statistical method aptly suited to such comparisons is the t test. For the sake of clarity, t ratios based on the change within each group will be designated by the usual t, while those relating to the difference between the changes in the two groups will be labeled t'.

In the presentation to follow, the instruments have been arranged in terms of approximate homogeneity of function rather than in terms of predicted superiority. That is, the presentation follows the sequence of tests of general intellectual functioning and memory, a measure of motor coordination and speed, techniques designed to reflect the total personality functioning of the individual, and rating scales selected to reflect various attitudes of the subjects and the general impression made upon the examiner by them. The section has been organized to permit a full description of the results by discussing each instrument in turn.

*Wechsler-Bellevue Intelligence Scale.* This scale contains 11 subtests sampling a variety of skills and yields separate scores on verbal and performance items. In table 1 may be seen the intelligence quotients and the deterioration ratios computed from this scale for the two groups.

As is apparent from the table, both groups are slightly below average intellectually in terms of norms established for the general population. There is at the time of the second test no significant increase in either group in the verbal, performance, or full scale IQ, nor any appreciable shift in the deterioration ratios.

Figure 1 depicts performance on the individual subtests, where, on the whole, little change is apparent. There are four within-group changes significant at the .05 level of probability, but in only two of these are the between-group differences significant. These occur in Information and Comprehension, the former due to a significant increase in the control group and the latter to a significant decrease in the control group and a slight rise in the experimental group. Two other within-group changes are significant, Picture Arrangement in the control and Picture Completion in the experimental group, but in each instance slight but nonsignificant increments

TABLE 1. MEANS, SIGMAS, AND MEASURES OF SIGNIFICANCE OF DIFFERENCE ON THE WECHSLER-BELLEVUE IN CONTROL (C) AND EXPERIMENTAL (E) GROUPS.

| | Mean Test 1 | Sigma Test 1 | Mean Test 2 | Sigma Test 2 | Difference | t | $D_e$-$D_c$ | t' |
|---|---|---|---|---|---|---|---|---|
| Verbal IQ | | | | | | | | |
| C Group | 86.67 | 9.45 | 86.40 | 9.55 | −.27 | .20 | .96 | .55 |
| E Group | 88.15 | 9.66 | 88.84 | 12.43 | .69 | .63 | | |
| Performance IQ | | | | | | | | |
| C Group | 88.60 | 9.23 | 90.60 | 11.08 | 2.00 | 1.38 | .15 | .07 |
| E Group | 89.77 | 12.00 | 91.92 | 9.40 | 2.15 | 1.60 | | |
| Full Scale IQ | | | | | | | | |
| C Group | 83.26 | 8.78 | 84.73 | 10.31 | 1.47 | 1.26 | 1.42 | .05 |
| E Group | 84.76 | 10.60 | 86.30 | 11.00 | 2.89 | 1.83 | | |
| Deterioration Index | | | | | | | | |
| C Group | 30.72 | 24.53 | 40.48 | 26.31 | 9.76 | 1.52 | −14.34 | 1.50 |
| E Group | 34.74 | 24.81 | 30.16 | 21.62 | −4.58 | .65 | | |

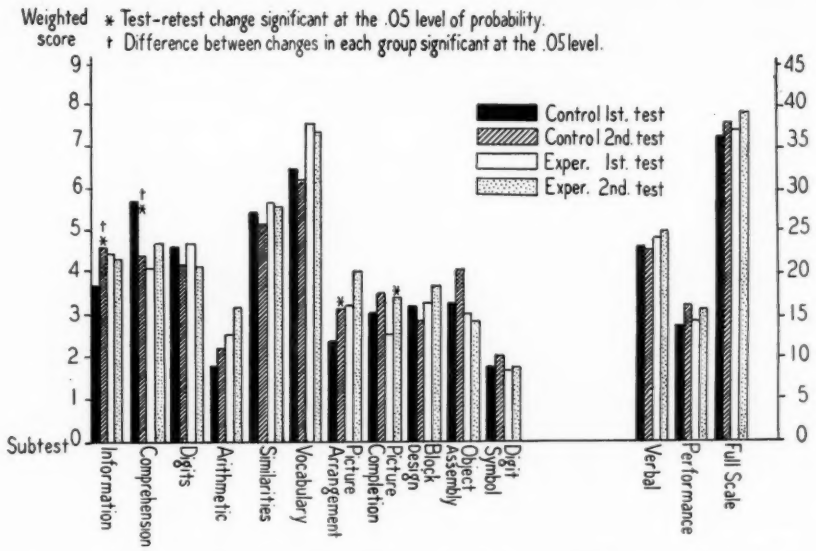


FIG. 1. Mean Weighted Scores on the Wechsler-Bellevue Intelligence Scale for Control and Experimental Groups on First and Second Examinations.

in the other group nullified the gains. Thus no appreciable superiority is held by either group at the time of the six-month retest.

Lest the relative paucity of concrete gains made by the treated subjects on this test be misinterpreted, a word of caution must be sounded. To a considerable degree, it measures abilities long since crystallized. Even on the performance scale, generally considered more capable of reflecting change, this group was handicapped by serious reduction in visual acuity and motor coordination. Accordingly, it was felt that other instruments might reflect more accurately any change which may have occurred.

*Wechsler Memory Scale.* This test is composed of 7 subtests sampling various aspects of visual and auditory memory. The age of the subjects in the present sample was greater in most instances than the subjects used by Wechsler in standardizing the test so that his formula for converting to memory quotients is inapplicable. Accordingly the units in figure 2 refer to raw score units.

On the subtests of Information, Mental Control, and Digits Forward and Reversed there was no significant change in either group. In figure 2 it may be seen that in Orientation and Logical Memory the control group decreased significantly between the first and second examination, while the experimental group either held its own or else improved slightly but not significantly. The difference between the magnitude of the changes shown by the two groups on these two subtests is significant in each case between the .10 and .05 levels of probability (t of 2.01 and 1.99, respectively). Next, on the Visual-Reproduction items, which consist of drawing from memory geometrical designs which have been exposed for ten seconds, both groups improve slightly, although the average improvement of .73 in the control group is significant while that of .46 in the experimental group is not. However, the difference between the gains is nonsignificant (t of .52). It is felt that this relatively greater change in the control subjects may be explained at least partially on the basis of overall visual superiority on the part of the control group. Although no concrete evidence can be presented to sup-

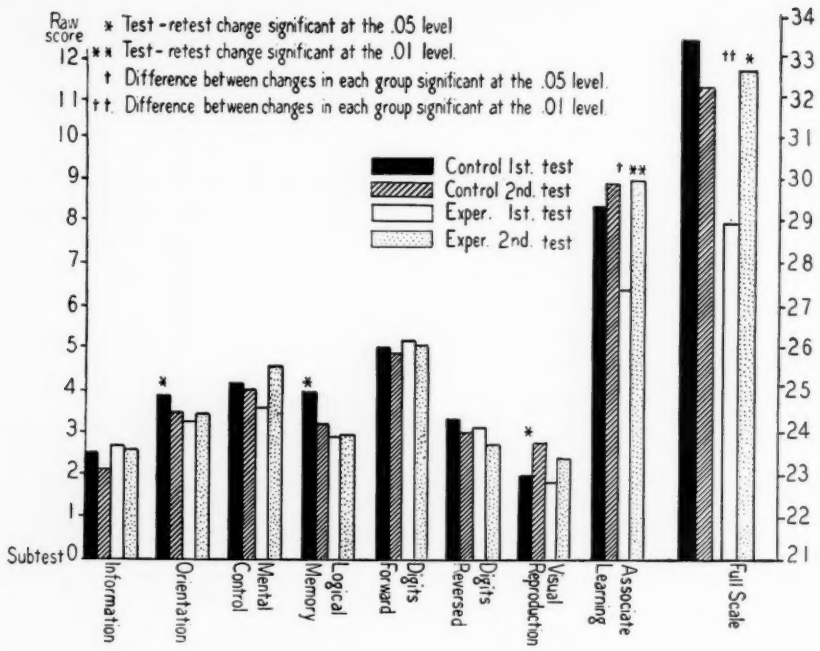


FIG. 2. Mean Subtest and Total Scores on Wechsler Memory Scale for Control and Experimental Groups on First and Second Examinations.

port this, it is noteworthy that in two out of the three improvements thus far cited which occurred in the control group the visual acuity demanded by the task is relatively great.

In view of certain widely-held hypotheses about the nature of aging in so far as mental processes are concerned, the comparison on the Associate Learning subtest appears extremely pertinent. That is, it is generally felt that a reduction in fluidity of thinking and a corresponding increase in rigidity of thought processes is frequently observed in the aged individual. Loss of this adaptability may readily be seen when the breakup of an old association and the substitution of a new one become necessary. Such a function is precisely what is required in this subtest. A list of pairs of words, some of which logically belong together (e. g., metal-iron) and some of which seem entirely unrelated (e. g., cabbage-pen) is read to the subject, following which she is asked to supply the second word of the pair after the first has been given. To succeed in this, one must be able to subordinate one's own associations to those required by the word groupings. On this task, the experimental group, which was originally less adept than the control group, increased its mean score from 6.35 to 8.85, which is significant beyond the .01 level of probability. Likewise the difference between the gains made by the two groups is significant at the .05 level.

In interpreting these findings, lack of information about the reliability of the individual subtests is an important factor. Nevertheless, the total score shows that while the performance of the control group has decreased slightly, the experimental group has improved its performance on this memory scale at the .05 level of probability. The difference between the gains is also highly significant ($P = .01$). Thus a genuine improvement in the

memory functioning of patients who have received the hormone therapy seems to be established by the data.

*Color Naming and Reversal.* In this test the subject is asked to name as quickly as possible a series of colored squares, with time and errors recorded. She is then asked to identify the colors again, this time reversing the names "blue" and "red," obviously a more difficult task and one requiring reorganization of pre-existing habit patterns. In young subjects any decrement in performance occurring when the reversals are required is generally in the form of an increase in time required to name the colors; errors, if appearing at all, are generally self-corrected.

With the present subjects this was not the pattern, as both experimental and control groups slow down markedly and make many unrecognized errors when the reversals are involved. Furthermore, both groups decline in performance level with the passage of time both in respect to time required to reverse the colors and number of errors made. The control group took on the average 111 seconds longer to reverse the colors and made 4.0 more errors on the retest, both changes significant at the .05 level. The experimental group slowed down an average of 50 seconds and made 2.69 more errors, neither change being significant. This pattern of results suggests the possibility that even though the endocrine therapy might not produce distinct improvement in a specific skill, it may serve to retard the deteriorative process which is normally taking place in individuals in this age range.

The differences between the two groups are not clear-cut, however, as an analysis of the disparity between the decrements shown by the two groups yields no significant differences. Therefore, any generalizations regarding the superiority of the experimental group on this particular task must be parsimonious.

*Homographs.* This test involved having the subject give as many meanings as she could think of for each of eight words, with the list containing such words as "file" and "round." The word "bill" was given as an example to make certain that the subjects understood the nature of the task. It was hypothesized that improvement on this task might reflect increased flexibility of thought processes.

Between the first and second tests, the control group increased from an average of 1.76 definitions per word to 1.84, while the experimental group improved from 1.58 to 1.80 definitions per word. Although the change for neither group nor the difference between the changes is statistically significant, the experimental group shows a slightly greater increment in performance level.

*Rate of Manipulation Test.* This test involves having the subjects replace as quickly as possible small round blocks into recesses on a large board. Two trials were given, and at the end of the first trial the subject was praised but urged to see if she could not possibly do it any faster. Originally the test was included to serve only as a test of manual agility and speed. The time required for the first trial, the second trial, or the average of the two trials showed no significant change from the first to the second test in either group nor a significant difference between the changes.

The test yielded another measure, however, which seemed to reflect a desire to work and to perform maximally, i. e., the amount of improvement from the first to the second trial. At the time of the first testing both groups responded to the request to try harder with an average improvement of about 6 seconds. On the second examination some of the lethargy of the experimental group had lifted so that their improvement score had increased to about 14 seconds, a change which is significant at the .05 level. Although the control group remained at practically the same level, the difference between the changes shown by the two groups is not significant. This increased response to the request to do their best found in the experimental group is perhaps more significant than would have been a few seconds' gain in overall performance time.

*Rorschach Technique.* This instrument, consisting of a series of 10 relatively amorphous ink blots about which the subjects are

asked to give their associations, is widely used today by clinical psychologists as a means of appraising the total personality functioning of the individual. Despite its wide use it has been applied to relatively few subjects within the age range of those used in the present study.

Table 2 presents the results found on certain scoring categories on this test. Several test-retest changes significant at the .05 level may be seen, all occurring in the experimental group and all meaningful in terms of the original hypothesis. First, there is an increase in the experimental group in total number of responses, indicating greater productivity and perhaps more wholehearted participation in the test itself. Although the control group has increased slightly in mean number of responses so that the difference between the gains is not statistically significant, the greatest amount of this increment was contributed by one subject who changed radically from 17 responses on the first examination to 41 on the second. Ac-

TABLE 2. MEANS, SIGMAS, AND MEASURES OF SIGNIFICANCE OF DIFFERENCE IN CERTAIN RORSCHACH SCORING CATEGORIES IN CONTROL (C) AND EXPERIMENTAL (E) GROUPS.

| Scoring Category | Mean Test 1 | Sigma Test 1 | Mean Test 2 | Sigma Test 2 | Difference | t | $D_e$-$D_c$ | t′ |
|---|---|---|---|---|---|---|---|---|
| Total Responses | | | | | | | | |
| C Group | 13.13 | 6.61 | 13.93 | 9.29 | .80 | .62 | .90 | .62 |
| E Group | 11.38 | 4.05 | 13.08 | 3.99 | 1.70 | 2.42* | | |
| Number of Rejections | | | | | | | | |
| C Group | 1.73 | 2.29 | 1.60 | 2.65 | −.13 | .25 | .26 | .38 |
| E Group | 1.31 | 1.81 | .92 | 1.00 | −.39 | .85 | | |
| Confabulations | | | | | | | | |
| C Group | .21 | .40 | .28 | .45 | .07 | .42 | −.38 | 1.15 |
| E Group | .54 | .93 | .23 | .42 | −.31 | 1.08 | | |
| Popular Responses | | | | | | | | |
| C Group | 3.07 | 1.75 | 4.00 | 2.20 | .93 | 2.06 | .38 | .59 |
| E Group | 3.46 | 1.65 | 4.77 | 2.08 | 1.31 | 2.86* | | |
| Original Responses (+) | | | | | | | | |
| C Group | .57 | .72 | .36 | .81 | −.21 | 1.12 | −.10 | .36 |
| E Group | .62 | .74 | .31 | .61 | −.31 | 1.49 | | |
| Original Responses (−) | | | | | | | | |
| C Group | .57 | .62 | 1.00 | 1.56 | .43 | 1.25 | −1.04 | 2.48* |
| E Group | 1.00 | .96 | .39 | .62 | −.61 | 2.53* | | |
| Amount of Z | | | | | | | | |
| C Group | 10.79 | 6.63 | 8.33 | 5.23 | −2.46 | 1.04 | 7.43 | 2.53* |
| E Group | 11.38 | 5.76 | 16.35 | 5.99 | 4.97 | 2.43* | | |
| F+ Per cent | | | | | | | | |
| C Group | 85.00 | 13.11 | 80.00 | 21.88 | −5.00 | .77 | 17.24 | 1.94 |
| E Group | 73.53 | 13.97 | 85.77 | 10.60 | 12.24 | 2.02 | | |
| A Per cent | | | | | | | | |
| C Group | 41.57 | 20.28 | 44.64 | 20.14 | 3.07 | .78 | .01 | .00 |
| E Group | 44.54 | 15.41 | 47.62 | 19.82 | 3.08 | .58 | | |

* Significant at the .05 level of probability.

tually 10 out of the 15 control subjects showed decreased productivity on the second examination, whereas only 2 of the experimental group gave fewer responses.

Another significant change in the experimental group was in the total number of popular responses given, which indicates closer agreement with the perceptions commonly reported by a majority of the population. This finding of increased commonality of thinking is supported by a significant decrease in the number of bizarre and disoriented original responses.

Another function showing a highly significant change in the experimental group is labeled "Amount of Z." According to Beck, Z pertains to the organizational activity of the subject and gives an index of "the intellectual energy as such, irrespective of the kind of intelligence" (1, p. 12). As a measure of thinking potentiality rather than results of such thinking it may actually give a more accurate representation of intellectual functioning than some of the more highly structured intelligence tests. In this category, while the control group drops from a mean of 10.13 to 8.33, the experimental group gains significantly in score from a mean of 11.38 to 16.35. The difference between the changes found in the two groups is also statistically significant ($P = .02$). It is in intellectual *potential* that one might expect improvement as a result of effective therapy. Furthermore, for subjects living in a relatively barren intellectual environment, improvement would almost of necessity be limited to this type unless the environment could be enriched to provide opportunities for expression of intellectual change.

The other categories in which change in a prescribed direction had been predicted were the F+ per cent and the percentage of responses with animal content (A per cent). The F+ per cent is interpreted as reflecting contact with reality and ego control, and here a significant increase in the experimental group was expected. The results show that while the control group drops in F+ per cent from 85.00 to 80.00, the experimental group gains from 73.53 to 85.77, an increase which is significant between the .10 and .05 levels. The 17.24 point difference between the change is significant at the same level. In regard to the A per cent, interpreted as reflecting stereotyped patterns of thinking, a decrease between the first and second examination in the experimental group was predicted. However, this was not supported, as there was no appreciable change in either group.

*Thematic Apperception Test.* This test consists of a series of pictures (8 used in the present study) about which the subject is asked to make up stories. The pictured stimuli are somewhat ambiguous, thus permitting the subject to project her own feelings, goals, etc. onto the characters in the pictures. The test is used as a means of assessing creative imaginative ability as well as general personality dynamics. Ordinarily more pictures (between 10 and 20) are presented to the subject than were used in this study, but because of time limitations it was impossible to include more in the experimental battery.

The first analysis was a simple word count to be used as a measure of the productivity of the subjects. Published reports indicate that the average length of stories for younger subjects is roughly 150 words (4). The present group is far less productive, with the control group giving on the first examination stories averaging 50.60 words in length and the experimental group only 48.51. At the time of the second examination, both groups were slightly more productive, with the control group averaging 59.83 words and the experimental group 61.80. The latter change falls just short of significance at the .05 level ($t$ of 2.12), while the increment in the controls does not approach the significance level ($t$ of 1.32). However, the difference between these two gains is not significant. This slight improvement in both groups probably reflects the fact that by the time of the second test all subjects were a little more accustomed to the task and less critical of it than had been the case initially.

In line with the postulated effects of the

hormone treatment, three general areas were regarded as worthy of investigation on this particular technique: mood, outcome, and time trend reflected in the stories. Under each of these general areas four categories of response were subsumed. That is, each story was rated as containing either a predominantly positive, neutral, or negative mood, or as having no mood at all; as having successful, unresolved, unsuccessful, or no outcome; and as having the bulk of the action take place in the past, present, future, or as having no time trend at all.

The reliability of this classificatory scheme was checked by having two raters rate 40 stories independently. By having the raters understand thoroughly what was meant by the individual categories, 85 per cent complete agreement was obtained on outcome, 95 per cent on mood, and 93 per cent on time trend. It was believed that this agreement was sufficiently high to warrant the use of the classification. All the final ratings were made by a trained psychologist who had had no contact with the patients and who saw none of their test material other than the Thematic Apperception Test protocols.

Figure 3 presents the results of this analysis. In the ratings of the mood contained in the stories, one change significant at the .01 level of probability appears. This is in the experimental group in the form of reduction in the number of stories having no mood. Inspection of the figure reveals that this reduction is accompanied by a slight but nonsignificant increase in the number of stories with negative

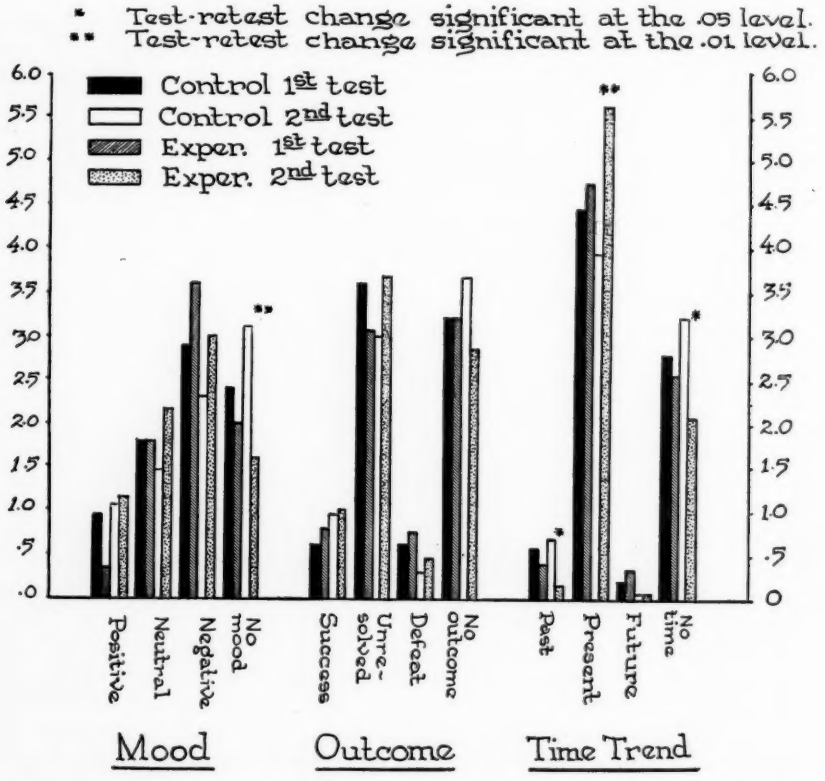


FIG. 3. Mean Ratings on the Thematic Apperception Test for Control and Experimental Groups on Mood, Outcome, and Time Trend on First and Second Examinations.

and neutral mood. Contrary to what might have been predicted, there was no increase in the number of stories reflecting a positive mood. The differences between the changes shown in the two groups are nonsignificant for each category.

A similar picture is seen in the outcome category. That is, in the experimental group there is a slight reduction (t of 2.01) in the number of stories giving no outcome, with the "unresolved" category taking up the greater part of this deficit. No clear-cut shifts are apparent in the control group; nor are the changes shown by the two groups significantly different.

The time trend of the stories shows a very interesting pattern. In the experimental group there is a significant reduction (.05 level) in the number of stories dealing with the past, and a corresponding increase (.01 level) in themes about the present. Both of these changes are accompanied, as would be expected, by a reduction (.05 level) in the number of stories having no time at all.

Although these changes are all meaningful and encouraging in terms of the original hypothesis, they must be interpreted with caution. The control group did not change its performance significantly, but even so the difference between the changes shown by the two groups is not significant for any of the categories. Nevertheless, the interpretation which seems justified is that at the time of the second examination the experimental group told better stories, whether or not the mood or outcome of these stories reflected positive feelings. Also there seems to be a shift away from thinking in the past to a greater concern with the present, a change which can only be salutary for a group of aged subjects for whom living in the past possibly increases dissatisfaction with the present. No such modifications are discernible in the untreated group.

*Interests and Activities Questionnaire.* This is a questionnaire developed specifically for this study which contains 43 items describing everyday activities which were likely to have been within the subjects' range of experience at some time during their lives. A patient is asked for each item if she participates in the activity now, if she used to do it, and if she would still like to do it if she were able and had the opportunity. It was designed to reflect desire to participate in the activities occurring in the hospital environment and also in the cultural milieu of the outside world in which the patients would be expected to move.

It had been expected that an increase in the "Like to Do" category and perhaps in the "Do" category would appear in the experimental group, but this was not the case. The only significant change was in the control group in the "Used to Do" category, one which should not have changed in either group if the reporting of the subjects had been completely reliable. None of the differences between changes shown by the two groups was significant.

*Hildreth Feeling and Attitude Scale (Modified).* This is a questionnaire including eight scales having to do with an individual's feelings towards other people and towards certain personal qualities such as health and energy. For the present study the scale was abbreviated to include but two sub-scales, one dealing with energy and one with reactions to other people. The subjects were to indicate any or all of the statements which they regarded as describing themselves, thus permitting an evaluation of the range of statements which they accepted as descriptive of their feelings as well as a general level of attitudes. It was considered that this procedure would cast some light on the critical judgment of the subjects by permitting them either to make or to refrain from incompatible choices.

The self-ratings made by the subjects on their own energy level and their feelings towards other people are tabulated in table 3. There was no significant change from test to retest in either group in respect to energy level, although here the trend was in the opposite direction from what would have been predicted. When feelings towards other people are evaluated, the experimental group is seen to have increased its rating significantly from a

TABLE 3. MEANS, SIGMAS, AND MEASURES OF SIGNIFICANCE OF DIFFERENCE IN RATINGS ON THE FEELING AND ATTITUDE SCALE IN CONTROL (C) AND EXPERIMENTAL (E) GROUPS.

| Scoring Category | Mean Test 1 | Sigma Test 1 | Mean Test 2 | Sigma Test 2 | Difference | t | $D_e$-$D_c$ | t′ |
|---|---|---|---|---|---|---|---|---|
| Energy | | | | | | | | |
| C Group | 4.86 | 1.56 | 5.34 | 1.42 | .48 | 1.22 | −.73 | 1.66 |
| E Group | 5.31 | 1.47 | 5.06 | 1.44 | −.25 | 1.41 | | |
| People | | | | | | | | |
| C Group | 5.87 | .99 | 5.53 | .91 | −.34 | 1.43 | .94 | 2.61* |
| E Group | 5.15 | .92 | 5.75 | 1.08 | .60 | 2.24* | | |
| Average No. Agreements | | | | | | | | |
| C Group | 4.96 | 1.54 | 4.75 | 1.25 | −.21 | .64 | .48 | .83 |
| E Group | 5.23 | 1.84 | 4.54 | 1.46 | −.69 | 1.44 | | |

* Significant at the .05 level of probability.

scale value of 5.15 to 5.75. The difference between the changes shown by the two groups is also significant at the .05 level of probability.

As the subjects were given an opportunity to indicate agreement with more than one item, it was felt that the spread of items accepted as describing their feelings might yield an index of certain judgmental faculties. Indisputably the patient who believed that both the statements "I am bursting with energy" and "I am completely worn out" described her condition was not exercising much discrimination in her responses. The measure used to indicate this critical judgment was the number of items accepted by each subject. When the average number of agreements in the two groups is considered, there is no change in either group which is significant at the .05 level of probability. The experimental group was somewhat more discriminating at the time of the second test, but there was so much intragroup variability that the total change was nonsignificant.

*Test Behavior Observation Guide.* This is a scale devised by the writers to quantify behavior observed during the examination. The ratings were anchored along a continuum of adequacy of the behavior for the examination, with behavior which would reduce the reliability of the test receiving a negative score and behavior favoring optimum performance rated as positive. The scale served to focus the examiner's attention on some of the intangible qualities which had been described by those observing the earlier group of similarly treated patients. Here the results as seen in table 4 are quite striking. The average rating on the control and experimental groups for the first examination were —9.00 and —12.69, re-

TABLE 4. MEANS, SIGMAS, AND MEASURES OF SIGNIFICANCE OF DIFFERENCE ON TEST BEHAVIOR OBSERVATION GUIDE RATINGS IN CONTROL (C) AND EXPERIMENTAL (E) GROUPS.

| | Mean Test 1 | Sigma Test 1 | Mean Test 2 | Sigma Test 2 | Difference | t | $D_e$-$D_c$ | t′ |
|---|---|---|---|---|---|---|---|---|
| C Group | −9.00 | 11.40 | −10.00 | 10.65 | −1.00 | .52 | 6.54 | 2.64* |
| E Group | −12.69 | 10.11 | −7.15 | 10.84 | 5.54 | 3.57** | | |

* Significant at the .05 level of probability.
** Significant at the .01 level of probability.

spectively. After six months of sex hormone therapy, however, the control group had dropped 1 point in average rating ( a nonsignificant difference), while the experimental group had improved 5.54 points in these qualities, a change that was significant beyond the .01 level of confidence. The difference between the changes was significant at the .05 level. These findings suggest that somehow the total behavioral gestalt of the experimental group had changed to a clearly observable degree.

*Composite Scores.* No attempt was made at the beginning of this study to order too closely the psychologic variables to be investigated. The impressions of those who had observed previous groups receiving similar endocrine therapy were accepted as valid to a certain extent, and instruments were selected to measure those particular attributes. To repeat, the psychologic variables considered worthy of investigation included general intelligence, memory, energy level, optimism, initiative, flexibility or rigidity of thought processes, environmental interests and activitives, contact with reality, and motivation. Although all these functions were by no means equally covered by the test battery, an attempt was made to obtain some information in each area.

In dealing with the data, however, certain hypotheses emerged as to what was taking place psychologically as the result of the treatment. An integration of test results with observational inferences suggested that whatever change occurred fell within one of three major categories. These may be described as intellectual potential, motivation, and flexibility of thought processes.

From an inspection of the concrete test results, it could not be said that there was a uniform change for the better in the experimental group. However, even a casual glance at the raw data suggests that there are many positive trends. That is, it was often observed that in a crucial function in which change had been expected, there might be a slight but nonsignificant positive change within the treated group and a nonsignificant negative change in the control group. This was a pattern which repeated itself many times. Therefore it was considered that possibly the objective figures themselves would yield more information about changes in these three major areas if the data were combined in a meaningful fashion. However, in view of the wide differences in scale units and variability in the different instruments, no direct summation could be made. A method which circumvents this difficulty can be found in the use of standard scores having a common mean and standard deviation for each test. To make such a comparison is statistically feasible, with the only critical issue being the selection of the tests which would make up the composite scores.

The ideal method for selecting these tests is a factor analysis of all the variables to see if three such factors actually do emerge, and, if so, which tests have heavy loadings. However, since the total number of cases in the study was smaller than would be desirable for such a study, it was decided that another method might serve as a satisfactory substiute. This was the method of having 3 judges rate independently which variables should reveal something about the subjects' relative standing with respect to these three hypothetical factors. The selection of a test was to be based entirely upon what was known about its rationale with no consideration of performance of the groups. The three general areas to be rated were defined for the judges as follows:

> *Intellectual Potential*—The potential ability of the individual to excel on intellectual tasks under conditions which would facilitate such performance. To be distinguished from intellectual *achievement*.
> *Motivation*—The drive which impels and sustains the individual to perform maximally within a given situation.
> *Flexibility*—The ability of an individual to change a given mental set and to assume a new one which is more compatible with attainment of a specific goal.

The criterion for the selection of the variables was at least two out of three agreement by the judges. Six tests met this criterion for Intellectual Potential: Compre-

hension (Wechsler - Bellevue), Similarities (Wechsler - Bellevue), Vocabulary (Wechsler - Bellevue), Associate Learning (Wechsler Memory), Z-Score (Rorschach Test), and Total Rorschach Responses. For the Motivation composite the items were as follows: Arithmetic (Wechsler - Bellevue), Total on Like to Do (Interests and Activities Questionnaire), Total Rorschach Responses, Average Length of Story (Thematic Apperception Test), Amount of Improvement (Rate of Manipulation Test), and Number of Rejections (Rorschach Test). The tests selected for the Rigidity-Flexibility composite were the following: Logical Memory (Wechsler-Memory), Mental Control (Wechsler-Memory), Number of Errors on Color Reversal, Homographs, Total Rorschach Responses, Similarities (Wechsler - Bellevue), Block Design (Wechsler - Bellevue), and Associate Learning (Wechsler-Memory).

Intercorrelations (using the method of rank difference) were then computed on the tests in an attempt to check statistically if they appeared to be related to one another. The correlations were consistently higher for both Intellectual Potential and Flexibility than for Motivation. In keeping with this finding, it is worthy to note that there was greater total agreement in the first two categories, while more of the tests placed in the Motivation composite were on the basis of two-thirds agreement only.

All the tests were then converted to standard scores with a mean of 50 and a standard deviation of 10. The actual mean and standard deviation in each computation were those obtained by the entire group of 28 subjects at the time of the first examination. Using these figures as a basis for computation, the standard scores on the selected tests were computed for both the first and second examination. The sums of these converted scores were then treated in exactly the same fashion as all the other data had been analyzed, with the intra-group differences between the two examinations and the difference between group changes constituting the relevant measures.

The results of this analysis appear in table 5. By means of this technique for combining scores, significant test-retest improvement is observed in the experimental group in all three categories. The difference between the group changes is significant for the Intellectual Potential and Flexibility composites. The significance of these results is attenuated somewhat by a consideration of the correlation between the composite measures. The rank difference correlations for the three measures are

TABLE 5. MEANS, SIGMAS, AND MEASURES OF SIGNIFICANCE OF DIFFERENCE ON COMPOSITE SCORES ON INTELLECTUAL POTENTIAL, MOTIVATION, AND FLEXIBILITY IN CONTROL (C) AND EXPERIMENTAL (E) GROUPS.

| Scoring Category | Mean Test 1 | Sigma Test 1 | Mean Test 2 | Sigma Test 2 | Difference | t | $D_e$-$D_c$ | t′ |
|---|---|---|---|---|---|---|---|---|
| Intellectual Potential (6 variables) | | | | | | | | |
| C Group | 303.93 | 38.93 | 297.33 | 45.67 | −6.60 | .87 | 25.98 | 2.35* |
| E Group | 295.69 | 39.25 | 315.08 | 53.67 | 19.38 | 2.40* | | |
| Motivation (6 variables) | | | | | | | | |
| C Group | 297.93 | 38.77 | 310.00 | 53.54 | 12.07 | 1.25 | 14.24 | 1.20 |
| E Group | 301.30 | 28.20 | 327.60 | 31.08 | 26.31 | 3.80** | | |
| Flexibility (8 variables) | | | | | | | | |
| C Group | 409.53 | 40.71 | 402.00 | 58.59 | −7.53 | 1.09 | 25.84 | 2.84** |
| E Group | 389.38 | 65.15 | 407.69 | 66.70 | 18.31 | 3.92** | | |

* Significant at the .05 level of probability.
** Significant at the .01 level of probability.

as follows: Intellectual Potential and Motivation, .544; Intellectual Potential and Flexibility, .771; Motivation and Rigidity, .413. These relationships are sufficiently high to suggest that possibly only one basic factor, having to do with the intellectual functioning of the individual, has been revealed. As this is an area of primary significance in our society, it would seem that the improvement represents a meaningful modification of behavioral determinants.

## Discussion

Following the presentation of results from the separate tests given in the previous section, it might now be well to integrate them quantitatively for a general perspective of the changes which took place between the first and second examination. Table 6 offers an overview of the results of all the within-group comparisons in which change in a given direction could unequivocally be interpreted as improvement. It must be pointed out that these comparisons are not independent and that there may be a high degree of relationship existing between some of them (such as scores made on subtests of the Wechsler and the total score). Nevertheless, the conditions are equal for the two groups, which is the crucial issue in such a comparison. In table 6 it is observed that the experimental group showed no significant declines, while the control group showed 5. In 17 of the comparisons the experimental group showed improvement significant at the .05 level, while in only 3 was this true of the controls (which may be attributed to chance when such a large number of comparisons is involved). Favorable changes significant at the .01 level of probability occurred only in the experimental group. This type of summary indicates that there was appreciably more change of a favorable nature in the experimental than in the control group during the six-month period of hormone therapy.

Table 6. Number of Significant Changes Made in Control and Experimental Groups in 69 Within-Group Statistical Comparisons.

| | Control Group | Experimental Group |
|---|---|---|
| Declines—.05 Level | 5 | 0 |
| Improvements—.05 Level | 3 | 11 |
| Improvements—.01 Level | 0 | 6 |

Beyond this brief quantitative summary of the findings from the present study, a few comments on certain features of the design are crucial to an unbiased evaluation of the results. Paramount among these is the question of the criterion of improvement which was selected, viz., performance on psychologic tests. Many attempts to show by means of these or similar instruments modifications which were believed to be related to a given independent variable (such as in the evaluation of psychotherapy) have produced negative or indefinite results. This does not prove, however, that the functions in question are not related; it may only reveal that the method of evaluation was not sensitive to changes which did occur. The acceptance of this criterion brings into focus the question of the applicability of psychologic tests for subjects in the upper age group. Although it is difficult to discuss this topic without delineating the exact instrument in question, a few general remarks can be made about the use of such tests with the present subjects.

In the first place, the reduction in visual and auditory acuity and the poor motor control present in the subjects made the task extremely difficult for them. Determining just how much of a task had been comprehended was often close to guesswork. The extreme demands made on the physical equipment of many of the subjects by this procedure increased their resistance by making it seem that too much was being asked of them. Furthermore, the entire procedure held an aura of mystery for the group, with their fantasies about the purpose of the examinations often producing a negative set toward them (e. g., the tests were being given to see if they were

"crazy," to determine if they should be transferred, put to work, etc.). Such factors could easily cause a purposeful dissembling of true feelings and thus bias the results somewhat. Another limiting factor was the fact that on many of the instruments the subjects were forced to think in the categories imposed by the test, a feat requiring in many instances more flexibility than subjects in this age range are observed to possess.

Implicit in these remarks about the test battery is a request for instruments designed for and standardized on subjects falling within this age group. Some of the techniques used in the present study are of unknown reliability and validity when used with older subjects, and these are crucial factors when comparing the performance given by a group at two different times. Furthermore, little is known about the psychologic meaning of the scoring categories of some of the instruments (such as the Rorschach and the Thematic Apperception Test) when the techniques are used with a comparable sample. In more objective tests the procedure for correcting for loss with age is to extrapolate from what is known about performance at earlier ages; such a procedure would be hazardous indeed in respect to the projective techniques.

Certain characteristics of the sample of elderly women used in this study also influenced the results. This group was in no respect representative of subjects of similar age in the general population. Many of them had had definite mental illnesses at one or another period during their lives and socio-economic status was below average for the general population. However, as was mentioned previously, the design of the experiment did not require a so-called "normal" group. The point is reemphasized here only as a reminder that in making inferences from these data a healthy caution is warranted until a similar pattern has been established in more representative groups.

Earlier it was pointed out that gynecologic criteria were given priority in matching the subjects for the two groups but that an attempt was made to permit relative equality with respect to certain variables such as age and intelligence. As a result of this matching there was no significant difference between the two groups in either of these variables, statistically speaking. But upon examining the exact figures, it is observed that the mean age of the control group was 74.25 and that of the experimental group 76.25. Although this difference is statistically nonsignificant, it may be very significant logically. That is, the experimental group is on the average two years older than the control group. In view of what is known about the rate of decline of most psychologic functions in the upper age range, this difference could prejudice the results in favor of the control group to a certain extent. For example, since the older subjects (the experimental group) would be declining at a slightly faster rate than the other group, changes which may justifiably be interpreted as significant would not necessarily have to be of the same magnitude.

An inspection of the raw data reveals that at the time of the first examination the experimental group was considerably lower than was the control group on many variables. A significant change in the treated group may have done little more than bring the treated subjects up to the level of the control group. Thus in terms of functions retained in the two groups at the beginning of the study, it would seem that the control group maintained a slight superiority in many areas. This uneven matching prevents direct cross-comparisons between the two groups.

In view of the many facts pointing to the need for more inclusive social and medical planning for the older age groups, it is apparent that a distinctly worthy research goal would be the development of techniques whereby these individuals can become more independent and better able to care for themselves during this period. Any therapeutic agent which can preserve the harmony of body functioning and at the same time enable older persons to retain a degree of independence in their daily living should be regarded as distinctly beneficial. It is not meant to imply here that

such has been proved in the present study. In fact, no test of independence per se has been attempted. It is only by inference that such a condition can be postulated as eventually emerging as a result of new and improved methods of therapy. Several patients in the present study were observed to take far more initiative for directing their own activities, a change which could be reflected only indirectly in the test results. However, it should be emphasized again that this experiment was conducted within a milieu which, of necessity, remained inflexible despite any changes which may have taken place in the individuals who composed it. Therefore the need for repeating such a study within an environment more sensitive to modifications within the individual should be emphasized.

## Summary

Thirty aged women, mean age 75.17, were selected for a study designed to investigate the psychologic effects of female sex hormones. Half of the patients received injections of the hormones (estrogen and progesterone) controlled in such a way as to induce cyclic bleeding, while the other half received injections of a neutral oil. No other differential treatment was accorded the two groups. Prior to the introduction of the hormone therapy and again after six months of the therapy a battery of psychologic tests was administered. The tests were chosen to sample such functions as general intelligence, memory, energy level, degree of optimism or pessimism, initiative, flexibility of thought processes, environmental interests and activities, contact with reality, and motivation. In order to minimize contamination of the results, the psychologist did not learn the identity of the two groups until after the second battery had been administered and scored. A statistical analysis of the results followed, comparing test-retest performance within each group and the difference between changes shown by the two groups by means of the t test.

The results of this analysis show many favorable trends which may be identified in the experimental group. Intellectual functioning, although not uniformly at a higher level, does show some improvement in so far as ability to think and willingness to expend intellectual energy are concerned. Memory seems definitely enhanced, particularly in respect to meaningful and logical material. Over the six-month period the experimental group made distinct gains in the ability to learn new material, even when this required the breakup of old associations which had long held sway. In certain areas where there was no intellectual improvement in the treated group, there was less of the decline than would have been expected by virtue of the increase in age of the subjects between the two examinations. The control subjects showed no more changes in these areas than would have been expected on the basis of chance.

It had been postulated that the treated patients would show a greater abundance of positive attitudes as a result of the sex hormone therapy. However, the findings in this area were less definitive. There was a slight indication of more favorable attitudes towards other people, but there was no general shift towards more positive attitudes. This appeared to be due partly to the fact that the available instruments designed to reflect this behavior were less adequate with the present subjects than they would have been with a youngr group.

The results of this study offer many challenges to the endocrinologist and to the specialist in geriatric medicine. While by no means suggesting that a panacea for all the mental ills and infirmities of old age has been miraculously supplied the treated subjects, the results are distinctly provocative. If the gains here reported are substantiated in other groups and can be maintained over longer periods of time, it is believed that an avenue of treatment possessing definite psychologic benefits for older females in our culture will have been demonstrated.

This study represents one aspeot of an interdepartmental project conducted by the Division of Gerontology, the Department of Obstetrics and Gynecology,

and the Department of Neuropsychiatry which required the cooperative efforts of many individuals other than the authors. Dr. William B. Kountz acted as coordinator of the project and directed the daily treatment and care of the patients. Dr. William H. Masters was in charge of the endocrinologic work. Appreciation is also expressed to Dr. Ivan N. Mensh and Dr. Philip H. DuBois for suggestions on research design and statistical analysis, to Dr. Dorothy T. Magallon and Mrs. Marjorie Titsworth for assistance in carrying out the endocrinologic work, and to Dr. Benjamin Pope for assistance in executing the statistical analysis of the data. Medication used in this study was supplied by Schering Corporation.

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# The Experience of a Group Insurance Plan with Older Enrollees

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## Program and Size of Enrollment

The Health Insurance Plan of Greater New York provides comprehensive medical care to its 282,000 enrollees (September, 1951) without extra deterring charges for any medical services they may require in their homes, physicians' offices, medical group centers, or in hospitals. It erects no barriers by reason of age, sex, or pre-existing illness, injury, defect, or pregnancy, either to admission to its rolls or to utilization of services thereafter. Reliance is placed upon group enrollment to protect the Plan against the adverse selection to which unguarded individual enrollment would expose it.

For the purposes of this paper the term older persons refers to those of 50 or over, but we shall present some figures for five-year age groups between 60 and 70. The enrollment after that age is not sufficient to warrant so fine a classification.

In this paper we shall review the previously published findings of the 1948 utilization experience of the older persons in HIP (2) and compare the rates with those of 1949. We shall add some new data for the latter year on the office, home, and hospital calls for older patients, on the types of physicians serving these older people, and on the surgical services they required.

The Health Insurance Plan of Greater New York is a voluntary, nonprofit corporation operating under the insurance laws of the State of New York and supervised by the state's Insurance Department. In previously published papers, its organization and operation have been fully described (1). Every kind of medical and surgical service is available to the subscribers, including x-ray and diagnostic laboratory services, physical therapy, visiting nurse services, and even ambulance transportation. Not included is treatment for drug addiction, acute alcoholism, or chronic conditions requiring care in an institution other than a general hospital. Drugs, dentistry, purely cosmetic surgery, eyeglasses, and other prosthetic appliances are also excluded. The care of persons suffering from conditions compensable under Workmen's Compensation and Veterans' Administration Laws is not covered by HIP, since these conditions are already covered outside of the Plan. This undoubtedly affects the HIP utilization rates for males of working ages and may affect the rate of some females of those ages, but the rates for children and the aged are not subject to this correction. These comprehensive services are rendered to the 282,000 enrollees by 30 groups of physicians without any financial deterrents to full and early utilization of the services. The only extra charge permitted is a fee of $2.00 for a night call requested and made between 10 p.m. and 7 a.m.

The 30 medical groups responsible for the medical care of the enrollees of the Plan include more than 900 physicians and specialists. Depending upon their enrollment size, the groups have from 6 to 28 general physicians, sufficient to provide all enrollees with a family doctor. Each group also includes qualified specialists in each of the twelve basic specialties of medicine and surgery and laboratory and x-ray departments which meet standards of HIP's Medical Control Board.

In analyzing the experience of the Plan with old people, it is necessary to emphasize that

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it does not include services often referred to as "medical," which are in reality social services, such as the care of the infirm aged in a nursing home or the prolonged stay of aged in hospitals or other institutions because of deficient home conditions.

The Plan lays special emphasis upon health education, preventive health examinations, and early recognition and cure of disease. In its comprehensiveness it differs from all other forms of nonprofit or commercial medical care insurance available in New York State. For this reason the City of New York, the United Nations, and more than 310 industrial organizations, private schools, labor unions, and voluntary welfare agencies in the city are paying half or more of the premium for all of their employees enrolled with the Plan and, in most instances, for their families. In several housing projects the tenants are enrolled and pay all of the premium with their monthly rent.

Enrollment in the Plan is open to groups as small as 10 having a common employer if at least 90 per cent join; to workers in larger employed groups or labor unions if at least 75 per cent join; and to residents in a housing project if at least 75 per cent join.

The New York State insurance regulations define a family as including the husband and wife and children up to the age of 18, so that dependent parents of workers are excluded even if they live in the same household. Nevertheless, a fairly large number of old people are insured under the Plan because of the absence of age limits.

From the inauguration of the Health Insurance Plan in March, 1947, to the end of June, 1951, a total of 730,000 years of coverage has been provided HIP enrollees. Of these, 142,000, or nearly one out of every five years of coverage, have been provided for persons aged 50 years and over.

As can be seen from figures in table 1, persons of 50 or over constituted 18 per cent of the total enrollment. On May 31, 1951, we had on our rolls about 15,000 persons over 60 and almost 6,000 who were over 65 years of age.

## The Aged in HIP

The recipients of public assistance have not been enrolled in the Plan. Many of the older HIP enrollees, both men and women, are still employed, but some have retired. In its original enrollment, one of the insured unions covered its already retired members. Some persons retired from employment or lost their jobs after enrollment in the Plan and retained membership in HIP. Some husbands and wives of employed enrollees were older persons

Table 1. Distribution of HIP Enrollment by Sex and Selected Age Groups, as of May 31, 1951.

| Age Group | Both Sexes | Male | | Female | |
|---|---|---|---|---|---|
| | | Number | Percentage | Number | Percentage |
| Enrollment, all ages | 274,565 | 144,077 | 52.5 | 130,488 | 47.5 |
| Total aged 50 and over | 50,251 | 31,549 | | 18,702 | |
| Percentage of total enrollees | 18.3 | | 21.9 | | 14.3 |
| 50–54 years | 20,278 | 11,847 | 8.2 | 8,431 | 6.5 |
| 55–59 years | 14,992 | 9,246 | 6.4 | 5,746 | 4.4 |
| 60–64 years | 9,151 | 6,105 | 4.2 | 3,046 | 2.3 |
| 65–69 years | 4,439 | 3,232 | 2.3 | 1,207 | 0.9 |
| 70 years and over | 1,391 | 1,119 | 0.8 | 272 | 0.2 |

and had retired before the time of enrollment. Others have since done so. Many wives were never employed.

It is to be noted that this experience does not include persons receiving care in institutions other than general hospitals. The average utilization of medical service by aged persons in an insured population living at home may be affected in some degree by the removal to institutions of those in need of custodial services. We doubt that the inclusion of such persons would greatly affect the general averages, since the segment of the aged population living in custodial institutions is not very large and their requirement is essentially for custodial rather than medical care.

While the HIP utilization experience of persons of 70 and over may not be absolutely conclusive, the utilization rates of 929 such persons in 1949 are consistent with those of the 619 persons who were 70 years and over in 1948. Since spouses, both male and female, can be covered by the employed person, and since people may continue their insurance if they are incapacitated for work, there is little reason to believe that the system operates to eliminate the sick from the enrollment once they have joined and do not enter a custodial institution or a public hospital.

## Utilization Experience for Older Persons during the Years 1948 and 1949

The utilization experience of 1948 is based upon 25,974 enrollee years of persons aged 50 years and over and that of 1949 is based on 39,479 such years. These enrollee years were distributed over the older age groups as shown in table 2.

Both in 1948 and 1949 the physicians' visits per enrollee (home, office, and hospital) were 4.28. This average number of professional services per year for the entire enrolled population does not include the laboratory services. The utilization rates which characterized the enrollees in the several older age and sex groups in these annual periods are shown in table 3.

The general utilization rate for persons under 50 years was 4.31 in 1948 and 4.34 in 1949. In 1948 the rate for the younger males was 3.98, that for younger females, 4.64.

Inspection of these figures on annual utilization brings out the following facts:

1. The utilization rates for all HIP enrollees were identical in 1948 and in 1949 and in both years there was comparatively little difference in the utilization rates for older and younger persons.

2. The utilization rate for older males in 1948 exceeded the rate for all males by slightly less than 7 per cent, or 0.28 of one physician service.

Table 2. Enrollee Years of Coverage by Sex and Selected Age Groups, HIP, 1948 and 1949.

| Age Group | 1948 | | | 1949 | | |
|---|---|---|---|---|---|---|
| | Total | Male | Female | Total | Male | Female |
| All ages | 116,940 | 62,469 | 54,471 | 198,386 | 106,014 | 92,372 |
| Under 50 years | 88,844 | 44,650 | 44,194 | 155,535 | 79,007 | 76,528 |
| 50 years and over | 25,974 | 16,893 | 9,081 | 39,479 | 25,424 | 14,055 |
| 50–59 years | 18,823 | 11,706 | 7,117 | 28,122 | 17,314 | 10,808 |
| 60–64 years | 4,484 | 3,101 | 1,383 | 7,105 | 4,856 | 2,249 |
| 65–69 years | 2,048 | 1,551 | 497 | 3,323 | 2,466 | 857 |
| 70 years and over | 619 | 535 | 84 | 929 | 788 | 141 |
| Age unknown | 2,122 | 926 | 1,196 | 3,372 | 1,583 | 1,789 |

TABLE 3. RATES OF UTILIZATION OF PHYSICIAN SERVICES RENDERED TO PERSONS AGED 50 YEARS AND OVER, BY SEX AND SELECTED AGE GROUPS, HIP, 1948 AND 1949.[1]

| Age Group | Total | | Male | | Female | |
|---|---|---|---|---|---|---|
| | 1948 | 1949 | 1948 | 1949 | 1948 | 1949 |
| Total, 50 years and over | 4.29 | 4.21 | 4.34 | 4.20 | 4.18 | 4.24 |
| 50–59 years | 4.20 | 4.11 | 4.13 | 4.01 | 4.33 | 4.27 |
| 60–64 years | 4.44 | 4.35 | 4.82 | 4.53 | 3.60 | 3.96 |
| 65–69 years | 4.55 | 4.71 | 4.87 | 4.80 | 3.56 | 4.46 |
| 70 years and over | 4.76 | 4.49 | 4.66 | 4.29 | [2] | 5.65 |

[1] Exclusive of services of radiologists and pathologists.
[2] Rate not calculated since enrollee-year base is less than 100.

3. The rate for older women in 1948 was *less* than the rate for all females by almost 8 per cent.

4. The rate for older women in 1948 was less than that of older men, with the widest discrepancies in the five-year age periods of the sixties.

5. Because of the preponderance of males over females among the older HIP enrollees, the rates both in 1948 and 1949 are excessively weighted with the experience of men, whereas the general population over 50 years is excessively weighted with women.

6. The experience of 1949 reveals approximately equal rates for all of the men and women 50 years of age and over.

7. As in 1948, the rates in 1949 for men in the sixties considerably exceed the rates for women of like age. The data for persons over 70 are too few for good comparison, particularly in the case of women (table 2).

8. The 1948 and 1949 rates for older men in each of the several age groups differed by less than 9 per cent.

When analyses of these data were made for the boroughs within New York City, the differences among them were found to be surprisingly small.

Terminal illnesses usually, although not invariably, occasion additional medical care. As the persons in the five-year age periods show varying proportions with terminal illnesses, their utilization rates will correspondingly register that condition. Although deaths call out service from the medical profession, it does not follow that the utilization rates in prior years are directly related to that event.

## PLACE AT WHICH PHYSICIANS SAW THEIR OLDER PATIENTS

Of the total services rendered to persons under and over 50 years, about the same proportion of visits in physicians' offices or the group medical centers was rendered to persons in each age group. These office visits account for more than three-quarters of all services reported. But, proportionately, only half as many *home* calls were made to older persons as were made to persons under 50 years. Among the entire insured population, children are the heavy consumers of home calls. On the other hand, the proportion of physicians' visits to older persons in hospitals was about 46 per cent greater than the proportion among younger persons (table 4).

When, as in table 5, the total visits per 100 enrollee years for each age and sex in the older group are distributed by place seen, major differences appear in the higher proportion of home visits paid to the women of 65 and over and of the hospital calls to all of the older men. The paucity in the numbers of women in the higher age groups renders the figures subject to considerable chance variation. But the figures for the hospital services for old men corroborate those found in other studies. On the whole, however, the figures for the several age-sex groups in these later periods are more striking in their similar-

TABLE 4. TOTAL NUMBER, RATE, AND PERCENTAGE DISTRIBUTION OF PHYSICIAN SERVICES BY PLACE SEEN FOR PERSONS UNDER AND OVER 50 YEARS OF AGE, HIP, 1949.

| Age Group | Total Services[2] | | Enrollee Years | Percentage Distribution of Physician Services by Place Seen | | | |
|---|---|---|---|---|---|---|---|
| | Number | Rate | | Total | Office | Home | Hospital |
| All ages[1] | 850,008 | 4.28 | 198,386 | 100.0 | 78.2 | 11.4 | 10.4 |
| Under 50 years | 674,480 | 4.34 | 155,535 | 100.0 | 77.9 | 12.5 | 9.6 |
| 50 years and over | 166,289 | 4.21 | 39,479 | 100.0 | 79.4 | 6.6 | 14.0 |

[1] Includes 9,239 services and 3,372 enrollee years with age unknown.
[2] Exclusive of services of radiologists and pathologists.

ities than in their differences. The total physicians' services used by these older people are certainly not so excessive as to constitute a serious burden upon the Plan and its participating physicians.

With the 929 persons of 70 and over, both men and women, consuming an average of 3.4 office visits, less than one-half a home visit, and less than three-quarters of a hospital visit throughout the year, a wide margin remains for persons of this age to increase their utilization without creating any serious pressure on the Plan.

## GENERAL PHYSICIAN AND SPECIALIST CARE FOR OLDER PERSONS

Under the HIP system of comprehensive medical services without financial deterrents

TABLE 5. NUMBER AND RATE OF PHYSICIAN SERVICES RENDERED TO PERSONS AGED 50 YEARS AND OVER, BY PLACE SEEN, SEX, AND SELECTED AGE GROUPS, HIP, 1949.

| Age Group and Sex | Total Services[1] | | Rate by Place Seen[2] | | |
|---|---|---|---|---|---|
| | Number | Rate[2] | Office | Home | Hospital |
| Total, 50 years and over | | | | | |
| Male | 106,635 | 419 | 330 | 25 | 64 |
| Female | 59,654 | 424 | 342 | 32 | 50 |
| 50–59 years | | | | | |
| Male | 69,415 | 401 | 321 | 24 | 56 |
| Female | 46,134 | 427 | 349 | 30 | 48 |
| 60–64 years | | | | | |
| Male | 22,011 | 453 | 346 | 28 | 79 |
| Female | 8,899 | 395 | 320 | 33 | 42 |
| 65–69 years | | | | | |
| Male | 11,833 | 480 | 366 | 27 | 87 |
| Female | 3,822 | 446 | 291 | 52 | 103 |
| 70 years and over | | | | | |
| Male | 3,376 | 428 | 325 | 31 | 72 |
| Female | 799 | 566 | 429 | 79 | 58 |

[1] Exclusive of services of radiologists and pathologists.
[2] Rate per 100 enrollee years.

to their utilization, specialist care is freely available to all enrollees. In table 6 the results of a broad comparison between the general physician and specialist care received by persons under and over 50 are displayed. From this it would seem that the older persons had a slightly larger fraction of their care given by the general physician than was the case with persons under 50. This discrepancy arises out of the large amounts of specialist care routinely given in pediatrics and obstetrics in the younger age groups. These figures would indicate that the specialist care of the older persons approximates that of other adults in 1949, aside from the maternity cases.

If there were gerontologists on the staffs of the medical groups, this picture might, of course, change very radically. Would they, as in the case of some of the pediatricians, supplant the family doctor in giving routine and preventive care, or would they receive only selected referrals, as do the other specialists? In the latter event, how would they fit into the general picture? Something of the topography of the specialists' territory may be gained from an examination of the distribution of the total services among general physicians and the various kinds of specialists (table 7).

A more detailed analysis by five-year age groups among these older people failed to reveal any material deviations in the pattern of distribution either for the men or the women from those shown in the totals for persons over 50 years. But some material differences do appear when these distributions are compared with those for the total insured population. However, when pediatrics is eliminated, comparison of these figures with those

TABLE 7. PERCENTAGE DISTRIBUTION OF PHYSICIAN SERVICES RENDERED TO PERSONS AGED 50 YEARS AND OVER, BY SPECIALTY AND SEX OF RECIPIENTS, HIP, 1949.[1]

| Physician Specialty | Male | Female |
|---|---|---|
| Total—Number | (106,635) | (59,654) |
| Percentage | 100.0 | 100.0 |
| General practice | 58.9 | 61.9 |
| Total, all specialties | 41.1 | 38.1 |
| Internal medicine | 10.6 | 9.3 |
| General surgery | 8.1 | 6.5 |
| Urology | 5.0 | 1.3 |
| Ophthalmology | 4.7 | 4.9 |
| Otolaryngology | 4.2 | 3.2 |
| Orthopedics | 3.8 | 4.5 |
| Dermatology | 3.1 | 2.7 |
| Neuropsychiatry | 0.5 | 0.4 |
| Allergy | 0.4 | 0.6 |
| Gynecology | .... | 4.1 |
| All other specialties[2] | 0.7 | 0.6 |

[1] Exclusive of services of radiologists and pathologists.

[2] Cardiology, gastro-enterology, physical medicine, proctology, and pediatrics (services of pediatricians on emergency duty at the medical centers).

TABLE 6. TOTAL NUMBER, RATE, AND PERCENTAGE DISTRIBUTION OF PHYSICIAN SERVICES BY SPECIALTY FOR PERSONS UNDER AND OVER 50 YEARS OF AGE, HIP, 1949.

| Age Group | Total Services[2] | | Enrollee Years | Percentage Distribution of Physician Services by Specialty | | |
|---|---|---|---|---|---|---|
| | Number | Rate | | Total | General Physician | Specialist |
| All ages[1] | 850,008 | 4.28 | 198,386 | 100.0 | 56.2 | 43.8 |
| Under 50 years | 674,480 | 4.34 | 155,535 | 100.0 | 55.3 | 44.7 |
| 50 years and over | 166,289 | 4.21 | 39,479 | 100.0 | 60.0 | 40.0 |

[1] Includes 9,239 services and 3,372 enrollee years with age unknown.

[2] Exclusive of services of radiologists and pathologists.

for all persons in HIP reduces these differences. It is then apparent that older persons require comparatively more services from internists, general surgeons, and urologists, as would be anticipated. Comparatively less service was received by them from allergists and, naturally, from gynecologist-obstetricians.

### Surgery for Older Persons

During 1949 a total of 1,175 surgical operations on persons of 50 years and over was reported either as major surgery (654) or as minor operations performed in hospitals (521). Physicians vary considerably in their interpretation of what constitutes reportable surgery performed in their offices or in patients' homes. Some invariably report the smallest procedure that can be technically described as surgery, while others do not label as operations such procedures as the removal of splinters from fingers or small cinders from eyes, the incision and drainage of small abscesses, or the reduction of a dislocated finger. Hospitalized cases provide, we think, a far more uniformly reported body of data and describe a considerably more important group of conditions.

In this connection it should be recalled that, under the HIP system, there is neither deterrent nor inducement to the resort to surgery for persons of any age or circumstance.

In these cases of hospitalized operations, those performed in 1949 for men of 50 years and over yielded a rate of 3.19 per 100 enrollee years while those for the older women yielded a rate of 2.60 (table 8).

These rates were found to be fairly consistent throughout the four large boroughs of the City of New York (Richmond at that time was not covered by HIP).

The discrepancy between the rates for men and women in regard to hospitalized surgery becomes less when only major surgery is considered. The rates for major operations for each sex and for selected age groups are shown in table 9.

A rate for major surgery for all of the older persons of 1.66 operations per 100 enrollee years is heavily weighted with the experience of men. This cannot be properly compared with a rate of 1.22 major operations per 100 enrollee years found among the younger HIP population because the proportions between the sexes are different in the two popu-

Table 8. Number and Rate of Hospital Operations Performed on Persons Aged 50 Years and Over, by Sex and Selected Age Groups, HIP, 1949.[1]

| Age Group | Male | | Female | |
|---|---|---|---|---|
| | Number | Rate[2] | Number | Rate[2] |
| Total, 50 years and over | 810 | 3.19 | 365 | 2.60 |
| 50–59 years | 513 | 2.96 | 295 | 2.73 |
| 60–64 years | 180 | 3.71 | 40 | 1.78 |
| 65–69 years | 93 | 3.77 | 23 | 2.68 |
| 70 years and over | 24 | 3.05 | 7 | 4.96 |

[1] Hospital operations include all major and minor operations performed in the hospital and, in addition, 6 major operations performed at a group medical center, 2 by orthopedic surgeons, and 4 by general surgeons.

[2] Rate per 100 enrollee years.

Table 9. Number and Rate of Major Operations Performed on Persons Aged 50 Years and Over, by Sex and Selected Age Groups, HIP, 1949.

| Age Group | Major Operations, by Sex of Patient | | | |
|---|---|---|---|---|
| | Male | | Female | |
| | Number | Rate[1] | Number | Rate[1] |
| Total, 50 years and over | 439 | 1.73 | 215 | 1.53 |
| 50–59 years | 269 | 1.55 | 179 | 1.66 |
| 60–64 years | 106 | 2.18 | 20 | 0.89 |
| 65–69 years | 51 | 2.07 | 13 | 1.52 |
| 70 years and over | 13 | 1.65 | 3 | 2.13 |

[1] Rate per 100 enrollee years.

lation groups. Although we have not yet established the difference in rates for surgery among all of the younger enrollees, there is every reason to believe that they would not be identical for the two sexes and that a preponderance of one sex in the covered population would affect the rate of the whole. The enrollee years for females under 40 in the 1949 HIP population actually outnumber the male enrollee years by about 5 per cent. From 40 to 50 the males predominate by 25 per cent while in the older age group the males exceed by 81 per cent. The annual rate for major operations for children under 15 was found to be 0.66 per 100 enrollee years in the last six months of 1949, with the rate for boys twice that of the girls. It seems that males require more surgery in childhood and in old age and females chiefly during the childbearing years and the early menopause.

From all the available data the conclusion seems evident that the older persons in the HIP population have required more surgery than the younger enrollees, with the demand from males exceeding that of the females. This is due only in part to their special need for urologic surgery.

## Health Examinations of Older Persons

One of the objectives of HIP is to bring to its enrollees the systematic practice of preventive medicine. Practically, this means the fusion of preventive measures, including health education, with the current medical care of patients. For our child enrollees the pediatricians do this very well. But for the adults, and particularly for the older persons with their fixed habits and attitudes, with their chronic conditions, and, often, with the unsuitable living conditions forced upon or deliberately chosen by them, such a program is not without its difficulties. The overcoming of these difficulties is the peculiar province of gerontology. The HIP setting makes it immediately advantageous to the physician to put into effect all that gerontology has to offer which will reduce illness and conserve or restore working capacity to the enrollee.

The integration of health education and preventive medical services with the general medical care of the whole person makes the statistical analysis of preventive medical services almost impossible. Visits of the patient for the routine care of minor as well as major conditions may be, in fact each should be, the occasion for making the patient more aware of his health assets and liabilities and of the ways by which the assets may be conserved and enhanced and the liabilities minimized. But no one, not even the physician who is highly health-conscious — as distinguished from disease-conscious—would label such services as public health procedures. By reason of this, the HIP statistical reporting system has had to be content with the collection of data on health examinations in which a person supposing himself well comes to the physician for a check-up.

The figures for services to older people of a purely preventive character shown in table 10 are therefore an understatement of the actual volume.

Table 10. Number and Rate of Health Examinations Received by Persons Under and Over 50 Years of Age, HIP, 1949.

| Age Group | Health Examinations[1] | | Enrollee Years |
|---|---|---|---|
| | Number | Rate[2] | |
| All ages | 45,788 | 23.1 | 198,386[3] |
| Under 50 years | 43,215 | 27.8 | 155,535 |
| 50 years and over | 2,573 | 6.5 | 39,479 |

[1] Health examinations are examinations with essentially negative findings rendered by physicians to apparently healthy persons.

[2] Rate per 100 enrollee years.

[3] Includes 3,372 enrollee years for persons of unknown age.

Comparison is made above of the rates for health examinations for persons over and under 50 years. Those under 50 years had a rate per 100 enrollee years of 27.8 such

services. This figure includes well-baby examinations which undoubtedly raised it considerably. The rate for the older persons is, on the whole, encouraging, for, in addition to the visits classified as health examinations (6.5 per 100 enrollee years), a large proportion of other visits represents, in effect, preventive services, since they are for patients with known chronic conditions which the doctor is watching and which, between them, the doctor and the patient are keeping under control. Many professional services of this nature would have been omitted if the patient were obliged to pay for each visit. It is expected that an intensive study now in process under grants of the Commonwealth Fund and Rockefeller Foundation will probe this matter further and perhaps result in the finding of more illuminating ways for presenting this phase of the HIP experience.

## Summary

In the sections above, the experience of HIP with its older enrollees during 1948 and 1949 has been reported. Unless, in its group enrollment process, it has attracted an excess of unhealthy people *under* the age of 50 and an excess of healthy ones *over* that age—which seems most unlikely—the experience of the Health Insurance Plan of Greater New York demonstrates that older persons are not inordinate users of physician services. Enrolled in the proportions in which they occur in the general population, older people do not present problems of any magnitude or seriousness to a properly conducted plan of prepaid comprehensive medical care. Those supported by public agencies, who are not enrolled in the Plan, constitute a peculiar medical care problem and their inclusion would require a modification of this statement.

Whether old or young, people who die from causes other than accidental usually, although not invariably, require substantial services in the terminal period of their lives. Utilization rates for medical services in the years in the life table in which deaths predominantly occur should reveal this demand. A plan of prepaid medical care which covers a true cross-section of the general population *outside of custodial institutions* cannot evade responsibility for the prolonged terminal care of such older persons.

HIP is intended to enable people of all ages to be better served by affording them the comprehensive benefits of medical group practice without any deterring extra charges and to spread the cost of that care among the population so that it becomes possible for the maximum number of people in the community to pay their way medically. Because the aging are still, and in the foreseeable future will continue to be, a relatively small fraction of the population—probably not over 13.2 per cent of the total population by the year 2000 will have attained their sixty-sixth year—we see no justification whatever for excluding them from participation in community plans for prepaid medical care. From the experience reported in this paper, there is no reason to believe that under group enrollment the inclusion of the aged in a prepaid comprehensive medical care plan should materially affect the premium rates necessary for good medical care of families at other stages in their life cycles, provided the older persons are enrolled in the same proportion as they exist in the general population.

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# Health Standards of Housing for the Aging Population

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HOUSING for the aging population presents a combination of problems. In some cases they are the same as, and in others vastly different from, those underlying the provision of housing for the general population. The problems are the same in the sense that basic economic, political, and social factors are present in both instances; they differ in the sense that there are special connotations of these basic factors which materially affect the provision of suitable living accommodations for older persons.

Since 1900 the proportion of the population in the age group 45 to 64 has increased approximately 50 per cent, and the proportion of the population 65 and over has almost doubled. Forecasts of population and age distribution indicate that by 1980 the proportion of the population 65 and over will increase by 20 per cent to 60 per cent above present day levels. The total number of persons 65 and over may almost double since the absolute increase in the next three decades has been estimated to be from 5,600,000 to 10,500,000 persons. It follows that the housing problem for aged persons will become more acute unless active steps are taken to solve it (3, 5).

The average number of persons per household has decreased from 4.8 in 1900 to 3.4 in 1950. Recognition of this trend along with skyrocketing building costs has resulted in smaller and smaller dwellings. They not only have less space but also fewer rooms, making it impossible for a large proportion of second and third generation families to provide accommodations, whether they wish to or not, for the first generation family.

While family income status is an inherent difficulty in the provision of healthful housing for the general population, it is particularly significant for older persons. With present day costs and in terms of typical dwelling designs, approximately four-fifths of the people over 65 years of age are unable to pay an economic rent. This presents an outstanding challenge to the ingenuity of this nation if we are to carry out the national housing policy established by the Congress in the Housing Act of 1949, wherein it was recognized that a decent home and a suitable living environment should be available for every American citizen. Those concerned with housing for the aged will have to think, for economic reasons alone, in terms of radical departures from presently accepted building practices if substantial inroads are to be made in solving the housing problem of the aged.

Chronic disease and other illness occurs more frequently in older people. This further complicates the problem and emphasizes the need for special services and facilities for medical care of aged persons in the home. Such facilities should be inherent in the structure.

The health factors in housing that may have special significance for older persons may be reviewed with the realization that aging is accompanied by a slow decline of the biologic and psychologic functions, by the onset of chronic illness, by an increase in the amount of all illness, by reduced activity, and by a greater general susceptibility to stress.

The Committee on the Hygiene of Housing of the American Public Health Association has developed an excellent set of health standards for housing entitled "Basic Principles of Healthful Housing" (2). These provide a

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sound framework for a discussion of health factors in housing that have particular significance for aged persons.

The principles formulated by the Committee are based on the fundamental biologic and psychologic requirements of the human organism. These principles are applicable to all ages. However, senescense is accompanied by physiologic and psychologic changes. Consequently, certain of the principles are especially significant when considering housing for the aged.

Our knowledge both of the psychologic and physiologic factors pertinent to aging and our knowledge of the manner in which these needs are related to housing is inadequate. Much research and investigation is needed. However, there is adequate information to indicate at least the particular significance of some of these principles.

### Fundamental Physiologic Needs

Aged persons, with poorer circulation and impairment of their heat regulating mechanism, are much more sensitive to their surrounding temperature than are young healthy adults. Additional clothing is not an entirely satisfactory solution to this problem. They need higher operative temperatures in their homes. The combined effect of air temperature and mean radiant or wall temperature is defined as operative temperature. Under ordinary conditions, operative temperature may be considered to be approximately the mean between air and wall temperature. Generally speaking, provision should be made for an operative temperature some 5 degrees F. higher than that required for the young healthy adult.

Furthermore, the heating system should be designed to provide a comparatively even air temperature from floor to ceiling. Older people are particularly sensitive to chilling of the extremities. Attention is directed to the fact that a thermometer attached to an inside wall 5 feet above the floor may register an air temperature 5 or 10 degrees higher than that at ankle height. Heating systems should be of such design and should use such fuel as to require a minimum amount of physical labor in their operation.

In the light of the impairment of the heat regulating mechanism of older persons, it is important to be able to regulate the thermal conditions to prevent over-heating. It is particularly desirable to be able to provide cool moving air in sleeping rooms. Because of their high costs it is hardly realistic to recommend air conditioning systems.

However, it is relatively economical to observe certain simple principles of design. Cross ventilation or its equivalent should be provided, particularly for bedrooms. Windows may be increased somewhat in size, perhaps 50 per cent above the usual minimum standard for the locality. The windows should be oriented to obtain the best exposure to the prevailing summer breeze. Furthermore, to facilitate the removal of warm air, the top of the window should be placed within 6 inches of the ceiling.

Gradual impairment of vision is an inherent part of the process of senescence. Large windows, suggested for adequate ventilation, will also assure more daylight. With windows reaching almost to the ceiling, glare from direct sunlight may be increased. However, slat blinds will control glare and permit ventilation.

The reduced ability of the eyes of aged persons to accommodate stress resulting from glare and high brightness ratios must be recognized. The artificial lighting system should be designed to provide 6 to 10 foot candles over the entire stairway and over the floor at an elevation of 30 inches above the floor; and 20 to 30 foot candles or more over areas used for reading or close work. Persons with severely impaired vision will need more than these amounts. Glare and brightness contrasts may be reduced by indirect lighting and proper placing of luminaires.

Old persons are housebound to a far greater degree than young people. It is essential, therefore, that they have plenty of direct sunlight in the home to provide the psychologic stimulation of its generally cheering aspect. Obviously the windows need to be larger and

properly oriented to the sun so that direct sunlight will enter both the living room and the bedroom at some time during the day. Due consideration must be given to land densities, high adjacent buildings and the need for housebound individuals to look out on pleasant surroundings.

Noise control is particularly significant for older persons since they are less able to adjust to external stresses. All dwelling units should be designed and located in such a manner as to reduce sounds from outside the dwelling unit to a level at least as low as 40 to 50 decibels, and 30 decibels should be attainable in sleeping rooms. Party walls should be designated to effect a reduction of at least 50 decibels of air-transmitted sound, and floors and ceilings should be capable of reducing impact noises by at least 15 decibels.

Since exercise has a beneficial effect on the circulation and appetite, as well as a psychologic value, adequate space for outdoor recreation should be provided. Provision should also be made for indoor recreation space involving mildly active games. In multiple-unit housing developments such space may well be provided on a community basis.

### Fundamental Psychologic Needs

Privacy is essential for older persons. This need is emphasized by the frequency of acute and chronic illness among older people. Furthermore, there is a special need to be able to avoid the daily living tensions and to have privacy for sedentary recreation and meditation. Therefore, older persons living in a household with others need a private room with ready access to a bathroom. This is desirable even though the other persons in the household may be close relatives.

The reduced ability of many older people to do physical work obviously requires a structure designed to ease routine tasks. The elimination of corners, cracks, and the provision of flush walls and smooth—but not slippery—floors, facilitates cleaning. The layout of the working areas of the dwelling should be designed to minimize walking and to provide easy access to storage closets and cupboards without excessive reaching or bending. Furniture should be easy to move to facilitate cleaning. Use of built-in furniture or furniture with casters is desirable.

In addition to the points just noted with respect to housekeeping, consideration must also be given to provisions for personal cleanliness. Although hot water under pressure inside the dwelling unit is desirable for all age groups, it is a necessity for the aged. This is true even though a daily bath may be exhausting and not absolutely necessary for all older persons. Spring type faucets should be avoided. Foot operated valves on lavatories may be used.

### Protection Against Contagion

A safe water supply is a health "must." As just noted, housing for older persons should have water supplied under pressure inside the dwelling unit. In addition to previously established bacteriologic and chemical standards for water quality, there are indications, at least for persons with cardio-vascular impairments, that sodium-free water is desirable (4, 6). The typical ion-exchange water softener used in areas where hard water abounds results in a high concentration of sodium ion in the softened water. The full significance of this for older heart patients is yet to be learned, as is the importance of the presence or absence of many other ions normally occurring in water.

Since older persons have reduced ability to clean house, it is important to design the dwelling to eliminate harborage for rats, cockroaches, and other vermin. Particular attention should be given to eliminating cracks and crevices in kitchen and pantries and minimizing vermin access-ways between dwelling units. Ratproofing of structures should be mandatory. Facilities for storing food and refuse, if properly designed, will assist in controlling vermin infestations.

In certain congregate living accommodations it is not always possible to provide private sleeping rooms. Since there is atrophy of the nasal mucosa in older persons and general

changes in the respiratory tract predisposing to respiratory illness, sleeping space should be adequate to limit the danger of the spread of respiratory infections (7). Information is not available that would indicate the desirable increase in space for older persons above the usual minima of 50 square feet of floor space and 400 cubic feet of air volume per occupant. Therefore, until reliable information is available, a 50 to 100 per cent increase above this minimum standard is suggested for design of this type of *congregate* sleeping quarters.

It is important to give extraordinary attention to the use of designs and materials that will reduce fire hazards. Ordinary precautions against fire do not suffice for several reasons. First, the ability of older persons to see and smell is reduced; second, they have decreased mobility which may reduce their ability to escape from a burning dwelling; and third, in senile persons, mental deterioration may be a factor in causing fires, escaping from them, or taking proper remedial action.

Even though homes may be fire resistant, fires may occur in them. The decreased activity of aged persons requires, therefore, that special attention be given to ways and means of escape. Dual means of egress should be available from all dwelling units. Considerations should be given to the design of fire escapes that aged persons can easily and safely traverse. There should be adequate night lighting of the fire escape.

The sense of smell in older persons is usually merely weakened (7). However, it may suddenly disappear for several months or more and may be recovered without apparent cause. In 1949 there were 1,200 reported deaths from home gas poisoning accidents. About 40 per cent of these deaths were among persons aged 65 and older. Approximately three-fourths of these fatal accidents were due to utility gas and carbon monoxide escaping from defective heating equipment. The remainder were due to carbon monoxide poisoning from standing vehicles and other poisonous gases (1). Accordingly, gas appliances installed in housing intended for occupancy solely by aged persons should be approved by the American Gas Association and vented to the outside air.

It is well known that older persons have more home accidents than younger adults. For that reason special attention should be paid to designs which will eliminate or reduce accident hazards. Fatal home accidents are approximately equivalent in number to the ninth leading cause of death. In 1949 home accidents accounted for 17,300 deaths among persons aged 65 and over. Falls account for more than one-half of these fatal accidents.

The bedroom and stairs are the principle sites of falls. Accidents in bedrooms can be reduced by giving attention to the design of the room and location of furniture to assure open passageways from the bed to the hall and/or bathroom door. Floor surfaces should be smooth, but not slippery. "Throw rugs" should not be used. Proper night lighting is essential and should include either small nightlights, for example, at baseboard level or a light switch beside the bed.

Falls on stairways can be reduced by proper design. In general, for adults, stairways should have slopes between 30 and 36 degrees. Tread and riser dimensions should be uniform throughout a stairway. Treads should be covered with non-slip surfaces. For adults, risers should not exceed a maximum height of 7¾ inches and the treads should have a minimum width of 9½ inches; for aged persons risers may be as low as 4 inches and treads 10 inches or more in width. Hand rails should be provided on at least one side, or on both sides if the stairs are more than 44 inches wide. The top of the hand rail should be 31 inches above the tread at the edge of the riser and should be continuous for the full length of the stairway. In long stairways there should be spacious intermediate landings. Stairs of less than 3 steps are always dangerous and should be avoided. The first and last steps should be clearly defined. Adequate lighting is imperative. In some cases it may be desirable to use ramps in place of stairways.

Window sills should be at least 30 inches high especially at stairway landings. Railings

or parapets at least 30 inches high and preferably 42 inches high should be provided around balconies, porches, sun decks, and accessible roofs.

Special precautions are needed in the design and construction of bathrooms. Tub and shower bottoms should be of non-slip materials. Grab bars to prevent falling and to assist in getting in and out of tub or shower are essential.

Thresholds, slight differences in floor elevations, and the "step-up" and "step-down" designs, should be avoided.

The decreased ease of movement and impaired sight and hearing of older persons lends special importance to the protection of the neighborhood against the hazards of automobile traffic. Good site selection and intelligent community planning can do much to minimize traffic hazards. New housing developments for older persons should be located so that access to all community facilities is possible with the least need for exposure to traffic.

## Discussion

From the foregoing it is evident that certain of the basic principles of healthful housing have special significance for older persons within the framework of existing knowledge. This knowledge will be broadened by gerontologic research. For example, in addition to the above considerations, it is known that older persons require considerable space for storage of their possessions which are such an important part of their life. It is impossible to say how much peace of mind a telephone or call bell by the bed can bring to aged persons, but their safety and labor-saving values are obvious. Likewise, who can estimate the value of living the remaining years in familiar neighborhoods? Or, in another vein, are we being short-sighted in building all dwellings for one and two generation family occupancy only?

Housing can be a positive factor in health. Adherence to the basic principles that have special significance for older persons should provide housing that will promote health and happiness.

Older persons are no more homogeneous than any other age group. Their wants are not the same. Neither are their physiologic and psychologic needs the same. An attitude truly considerate of these differences, coupled with recognition of the basic economic, political, and social factors pertinent to aging and with recognition of the special connotations of the basic principles of healthful housing, should foster vast improvement in the housing of older people. There must be added the motivation to accomplish such a task, which challenges our ability and ingenuity. There must be an enormous amount of research and investigation. There must also be systematic application by federal, state, and municipal authorities, and by the building industry, of existing knowledge of the health needs in housing for the aging population.

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# Final Report
# Second International Gerontological Congress
## St. Louis, Missouri (U.S.A.) September 9-14, 1951

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## I. INTRODUCTION

Without question the Second International Gerontological Congress was an event of far-reaching importance. Drawing upon the experience and interest of over 50 nations and upon the contributions of about an equal number of scientific and operational specialties, the participants surveyed the myriad problems of aging and the aged in the countless ways which underlined the universality and range of issues. The thousand or so delegates and aids who attended the meetings brought together for the first time the discoveries of science and their development and utilization in diverse fields. In various areas, they reported measurable results and, in general, defined action programs which it was hoped would be of constructive value to both aging individuals and to society.

For administrative purposes, the program of the Congress was divided into four sections: I. Biology and Medicine, by far the largest, covering both general research and the specific diseases and conditions associated with aging; II. Psychology, Sociology, Education, and Religion, concentrating on the life processes of the individual, the group, and the community; III. Economics, Employment, and Welfare, concerned with general population trends as well as the impact of an aging trend on specific social and economic issues; IV. Medical Services, Hygiene, and Housing, underlining the preventive and constructive approaches to maintenance of health and the care of the older generation. The present report,[1] however, is organized according to functional rather than administrative concepts, and aims to reflect the overlapping of interests on the part of the different sections.

### *The Congress Philosophy*

The broadening view of gerontology—extending from fundamental research in the biologic and physical sciences, the application of findings through medicine and the health services, through economic and social studies and services—symbolized the conference and highlighted the recommendations of the sections. The entire Congress, whether in general session or working in small specific discussion groups, was marked by the interdependence of the many disciplines focused on the aging.

Not only did the Congress serve as a meeting ground of solid achievement untrammeled by national boundary or professional status, but it brought a firmer realization that, through collaboration and interchange of knowledge at all levels, the essentially human issues of older individuals and of a rapidly growing older population, generally, can be recognized and a foundation laid for further research and action. This awareness emphasized the positive role of older people in a dynamic world and community—as part of a larger group including many with common and competing problems and demands—requiring full appreciation of special needs in a general and universal context.

### *The International Organization and Its Role*

The five-day Congress at St. Louis was held as the third in a series of national or international conferences on aging devoted to an orderly accumulation of knowledge and discussion of matters of mutual interest. Exchange and development of fact, principle, and theory has thus proceeded among governments, research and action organizations, and individuals by means of presentation of scientific papers, panel discussions, symposia, exhibits, and, perhaps most, through professional and social contact of workers. The first international conference, held in Liège, Belgium, July 10-12, 1950, represented societies of twelve countries and created an international association to promote gerontologic research in the social, medical, and biologic fields and further its interests through international recognition. The first international meeting was followed by the National Conference on Aging sponsored by the Federal Security Agency in August of 1950. This meeting identified hundreds of Americans concerned with problems of aging and helped set the stage for broad participation in the Second International Gerontological Congress.

[1] Dr. E. V. Cowdry, President of the Second International Gerontological Congress, initiated and assumed the formal responsibility for the preparation and publication of this report.

The report is based on information supplied by the chairmen of the various sessions. It was prepared with the assistance of Irving Ladimer of the Federal Security Agency together with Irving Goldberg, George Leibowitz, Nathan W. Shock, Annabel Wehrwein, and Merrill Rogers, all of the Agency staff; and under the general supervision of Clark Tibbitts.

Publication of this report in this issue of the Journal of Gerontology is made possible by a grant from the Second International Gerontological Congress.

*Congress Organization*

The Congress was organized and conducted under the auspices of the International Association of Gerontology, the president of which was Professor L. Brull, Clinique Médical B, Hôpital Bavière, Liège, Belgium. President of the Congress itself and newly-elected president of the Association was Professor E. V. Cowdry, Washington University, St. Louis, Missouri, U.S.A.

President Cowdry had the assistance of a vice-president, Mr. Clark Tibbitts, whose services were loaned by the Federal Security Agency, and of four section chairmen:

Section I. Dr. John Esben Kirk, Division of Gerontology, Washington University School of Medicine.

Section II. Dr. Robert J. Havighurst, Chairman, Committee on Human Development, University of Chicago.

Section III. Mr. Wilbur J. Cohen, Technical Advisor to the Commissioner for Social Security, Federal Security Agency.

Section IV. Dr. Joseph W. Mountin, Chief, Bureau of State Services, Public Health Service, Federal Security Agency.

The President of the Congress also set up a number of committees that rendered signal service in planning, organizing, and conducting the meeting. Membership of these committees, a list of the member societies in the International Association together with the names of their official representatives, and a list of the cooperating organizations are all given in the official program.[2]

The Congress wishes to express its gratitude to the Macy Foundation for its help and cooperation. By electing to holds its annual conference on aging in St. Louis a few days before that of the Congress, it enabled many delegates to attend the latter without extra cost, and it also paid the travel expenses of many delegates from foreign countries who might not otherwise have been able to attend. Contributions to foreign travel expense were also made by Washington University. And both Washington University and St. Louis University, assisted by many citizens of St. Louis, provided generous entertainment for the delegates of the Congress during its five-day session.

*Next Steps*

A plan for systematic research between congresses was suggested. The plan calls for continuing research, as a cooperative international effort, which will apply immediately and practically to new discoveries in biology and medicine. There would be research sessions devoted to organization and promotion of studies on old age and the investigation of promising leads. One such research session on the relation of hormones to aging was approved by the Congress. This session on endocrinologic research is already incorporated in the association created at Liège in 1950.

The next international meeting will be held in England in 1954.

*The Report of Proceedings*

Manifestly, no brief account such as this can adequately present the full substance of the discussions that took place or convey the rich background of experience from which the individual presentations and commentary were drawn. Abstracts of papers were published in the program (Supplement to the Journal of Gerontology, July, 1951, Vol. 6, No. 3) in advance of the congress and summaries as well as full texts of many of the reports have since appeared in various journals. The full and vigorous effect of the Congress, however, will be felt in the advancements in scientific research and activities which result from the stimulation and support provided by it and from a heightened appreciation, in general, of the problems of the aging.

An index to these programs is provided in the highlight reports and recommendations for investigation and action developed by each of the Congress sections. A summary of proceedings and recommendations, appropriately integrated in realization of the interdisciplinary character of the Congress, are presented as Part II of this statement. Part III is a topical summary or review of the substance of the addresses and discussion.

## II. SUMMARY OF PROCEEDINGS

The work of the Congress was conducted through four major interest groups employing a variety of techniques—individual presentations, panel discussions, problems identification sessions, committee considerations—for overall consideration of issues within their compass and for synthesizing their findings and recommendations. During the five-day session the number of scientific presentations made, and papers read, came to something over 400.

*Biology and Medical Research*

Discussions within the general field of biology, ranging from clinical case reporting to theorization were numerically the most important. Over 200 individual reports addressed themselves to various problems including genetic aspects, structural changes, cellular functions, organ systems, and nutrition. The most expansive area, medical aspects—in which over half of the papers were recorded—covered specific disease problems, as well as specific and general therapy. Rounding out the presentations in this field

[2] The official program was published as a special supplement of the *Journal of Gerontology* and is obtainable from the Journal of Gerontology, 660 South Kingshighway Blvd., St. Louis 10, Missouri ($2.50).

were panels on therapeutic aspects, geriatric medicine, and a round table on the definitions and concept of aging.

*Genetic Aspects of Aging.* General agreement was expressed that there is a need for extension of research on the role of the cytoplasm in aging. Such investigations were considered necessary in order to reveal hereditary, possibly cumulative, trends not explainable in terms of classical genetic inheritance.

*Cellular Aging.* Observations that in a wide variety of organisms, calcium accumulates in the region of the cell surface and that removal of the calcium tends to increase life span were given prominence in reports on cellular aging. The suggestion was made that calcium is bound to ribonucleoprotein and that age changes in the composition of this protein are reflected in the calcium binding.

Emphasis was given to the recent observation that desoxyribonucleoproteins do not seem to be exchanged in the cells, and to the possible significance of this finding with regard to the aging process. There was general agreement among the participants that the demonstrated lack of turnover of desoxyribonucleoproteins suggested an area for further research to be correlated with studies of turnover changes with age in other tissue components. It was the expressed opinion that too little work is being done at present in the field of cellular aging.

Concerning the age changes in connective tissue, the frequent lack of agreement between conclusions based upon staining with standard histologic techniques and the findings obtained with the electron microscope was stressed.

The role of fibrosis in limiting the metabolism of parenchymal structures was further recommended as an area for study. For the investigation of the submicroscopic structure of connective tissue the combined approach through the use of phase contrast microscopy, x-ray absorption, ultraviolet spectrography, and electron and polarization microscopy was suggested.

*Structural Changes with Age.* All papers reporting anatomic data emphasized the difficulty of correlating the observed structural variations with the process of aging. Most of the variations observed in advanced age occur also in younger individuals; many of the variations described can be produced experimentally in animals. They seem to be related to the nutritive and functional states of the tissue as well as to age. There seems to be no satisfactory criterion for the recognition of structural changes in nerve tissue that are primarily related to age.

The importance of early and adequate fixation of nerve tissue for histologic and histochemical studies was emphasized. The difficulty of obtaining human tissues immediately after death was fully recognized. It was therefore regarded as important to encourage the maintenance of colonies of small animals, such as rats and guinea pigs, in a healthy condition, with a supply of animals of all ages, so that there might be adequate sources of material for the study of aging.

*Cardiovascular Disease.* In this area, it was suggested that carefully prepared autopsy records be studied to elucidate the etiology of chronic degenerative diseases of the cardiovascular system. There is need to study the family histories, racial origin, social and economic status, dietary and other habits of life of those individuals found to have minimal or no coronary sclerosis, aortic atherosclerosis, or vascular nephritis as compared with those persons who showed such changes in a moderate or marked degree. Through such study data might be provided which would be of assistance in establishing ways of preventing such diseases and of combating them.

The importance of disturbances in the intermediary tissue metabolism for the development of arteriosclerotic lesions was indicated through investigations on the production of experimental arteriosclerosis in rhesus monkeys subjected to protracted pyridoxine deficiency.

Several new avenues for research in arteriosclerosis were brought to the attention of the participants. It was agreed that material from animals in zoos and human tissues from the coroners' and medical examiners' offices should be made available for study. Problems of adaptation, of endocrinopathies, and of intermediary tissue metabolism should be investigated in the light of the general problem of arteriosclerosis. It was further recommended that geographic pathology and geographic medicine should be organized on an international scale, possibly under the auspices of the United Nations.

The general opinion was expressed by the group that all efforts should be made to set up standards with regard to nomenclature, clinical and anatomic criteria, and chemical and other laboratory methods in order to achieve the uniformity essential for progress.

On the subject of hypertension in relation to aging, the majority of the papers dealt with basic problems concerning the pathogenesis of the elevated blood pressure. Particular interest was attached to a report on histochemical alterations revealed by tetrazolium in the convoluted tubules of hypertensive kidneys from both man and animals. These findings constituted the first demonstration of a cellular, presumably enzymatic, lesion in a specific segment of the kidney tubules in experimental renal and human essential hypertension.

The present status of the kidney in the pathogenesis of hypertension was considered in detail. Studies have indicated that the amount of renal tissue present in the body seems to be inversely related to the degree of hypertension, and further reported investigations indicated that total nephrectomy will produce a severe form of hypertension followed by the development of

arteriosclerosis. It was emphasized that the last named experiment seems to challenge the contention that hypertension is a result of liberation of pressor agents by the kidney. Attention was called to the important point that the technique described for maintaining nephrectomized dogs alive for prolonged periods offers a method for studying the evolution of the arteriosclerotic changes seen in hypertension.

*Endocrine Aspects of Aging.* Clinical and laboratory diagnosis of endocrine disturbances is still extremely uncertain. Research must be directed towards improvement in diagnostic methods, since there is reason to believe that disturbances of the endocrine system constitute major factors in reducing the efficiency and health of the aged. The importance of diverse experimental procedures which might be brought to bear upon the problem was stressed. These would include not only a consideration of the functioning organism, but also an evaluation of cellular responses in tissue cultures under controlled experimental conditions.

*Biologic and Physiologic Aspects of Aging.* It was agreed that there is a need for further studies on comparative aging—in other species, phyla, and genera. Such investigations, besides defining eventual differences in aging patterns, should consider whether such differences could be related to varying life patterns and functions.

The opinion was further expressed that there seems to be a need not only for additional descriptive studies on aging individuals and aging organs, but, more important, for a correlation of function, not only during basal states, but more especially during stress, to descriptive states. Finally, the significance of extension of research on the development of methods for evaluation of physiologic age was given emphasis.

*Cancer and Aging.* Because of the complexity of the process of aging and the process of carcinogenesis and because our knowledge of these processes is so scanty and views so conflicting, the relation between cancer and aging cannot now be set forth at present in clear-cut terms.

It was agreed that:

1. There is no established definite relationship between cancer and aging. In fact, most observations indicate that the relationship may be more coincidental than actual. Some types of cancer, however, may be due in part to changes in internal environmental factors associated with the aging process.

2. The terms "senile cancer" and "the cancer age" are misleading and should not be used.

3. Clinical observations suggest that cancer, as a rule, is less malignant in older persons than in young people.

4. Cancer can be induced experimentally in young animals. There seems to be an inverse relationship, —the older the animal the more difficult it is to induce cancer. Generally speaking the tissues of young animals are more susceptible to experimentally induced cancer than adult tissues.

5. Cancer cells and normal cells grow better in sera from young animals than in sera from old animals.

6. Numerous and complex factors can be observed influencing the carcinogenic process, including susceptibility of the species and the individual, condition and nature of the carcinogenic agent, and state of the individual.

Continued intensive research into the biophenomena of cell-growth, cell-division, cell-differentiation, cell-organization, and cell-mutations was strongly urged.

*Gynecologic Aspects of Aging.* Most interest centered about the problem of whether aging following menopause should be prevented by the prolonged use of sex steroids. In this connection the probability of the induction of cancer in the reproductive organs by the use of sex steroids was considered in detail. No definite agreement was reached on either of these two questions. The concensus was that more rather than less steroid therapy will probably find its way into the practice of medicine.

### *Personal Adjustment*

Discussion of the human being as an individual and as a member of society was characterized by the conviction that studies of people must be developed to the levels attained in the physical and biosciences. Strongly recommended to students of human behavior was an alliance with biologists and physicians in studies of the same individuals. Such joinder, it is believed, will not only add knowledge but also multiply knowledge. Perhaps more than any other series of discussions, those concerned with sociology, psychology, education, and religion recognized the deep and close relation of these aspects of gerontology to other areas, primarily in the fields of welfare, employment, health and hygiene, and in community service. Free lending and borrowing among these disciplines and professional workers to improve opportunities for the aging and aged was recognized as essential to progress.

### *Mental Ability and Psychologic Processes*

The relationship between aging and mental ability was explored in several presentations. Generally, there was confirmation of findings that thinking processes slowed up with advancing age but that essential powers were maintained through the years. Several investigators suggested that those who enjoy life spans extending beyond seven decades are mentally superior to those who die at younger ages. Association between psychologic and physiologic change was examined in a study of verbal fluency, suggesting that older individuals may show retardation in fluency beyond that associated with slow-up of motor processes. On the other hand, results of a battery

of tests including intelligence and motor response indicated that declines accompanying aging may in part result from sensory and motor impairment.

*Personality and Aging.* Concern with the attitudes of the aged towards society's recognition of their problems and their contribution and, on the other hand, with society's views of the aged as a group was expressed in several studies now under way in both a current and historical framework. There was general confirmation of the view that the elderly are confronted with negative attitudes and their ability to take part in society is conditioned by this overriding circumstance, despite what often seems to be a show of respect and reverence. Attitudes are generally formed by stereotyped views which have no scientific validity concerning the nature of old age.

*Outlets for Older People.* Stressing that institutional existence for older people removed them from the significant life stream of the community, attention was given to the opportunities available for continuing identification with the community. It was indicated that to a greater extent than their juniors, older people seem to be willing to participate in neighborhood ventures and to make use of specialized community facilities. Implications were seen for:

1. *The Church.*—Churches and synagogues, from the earliest times, have cared for their aged people. They should continue this function and adapt it to the needs of older people in terms of present day thinking in respect to the problem.
2. *Recreation.*—The same principles of recreational services apply to recreation for older people that apply to recreation generally. Older people have demonstrated that, with proper economic support, they can take the initiative in the organization and management of such services.
3. *Education.*—Adult educational programs for older people are being developed in several of our large cities and in some of the states with large rural populations. There is a great need for educational programs dealing with planning for later maturity, as well as for educational programs that appeal to adults regardless of age.

*Research Proposals.* The section participants agreed that gerontologic research should cover at least the age span from middle age to the end of life. Gerontology is concerned with both the process of aging and its end product, the aged individual. Studies of people should be related to other animal studies which can give light on human behavior. However, studies both of the longitudinal and cross-sectional type are needed. The longitudinal studies will follow carefully selected individuals through time while the cross-sectional studies will deal with appropriate samples at a given time period.

Studies in which social and individual factors can be related were recommended in the following areas:

1. Longitudinal studies, using (a) personal documents, diaries etc., (b) current testing of individuals formerly seen in clinics, schools, and military installations using objective test data already available on individuals tested when objective measurements were first introduced, (c) contemporary follow-up studies of individuals through the life span.
2. Investigations into the relation of early life problems to those of later maturity studied by clinical methods on the hypothesis that the crises of the aged are a secondary effect of the adolescent crises.
3. Investigation of the concepts of rigidity, variously defined, as an attribute or attributes of the aged.
4. Validation of clinical impressions arising from somatic treatment by use of psychologic test devices.
5. Studies of social roles and personal adjustment of people in middle age and later years; changes of these roles with aging and the relations of personal adjustment to social roles.
6. Investigation of the status and roles of older people in contrasting communities.
7. Studies of the interrelations of work and leisure-time activity in the life of the individual and of changes in these interrelations from middle to old age.
8. Research on the self-concept of the older person in relation to changing age and changing role.
9. Studies of matched groups in which an important factor is varied such as arbitrary retirement *vs.* self-initiated retirement.
10. Studies of changing value systems of older people directed towards their own age, to social participation, and to their change with age.
11. Investigation of the relation of attitudes towards functions to performance on objective tests of these same functions.
12. Studies of the personality of the aged, to round out existing personality studies.

Integrated research involving both the worker in the field and the research scientist should be encouraged. A series of problems for continued research of this type would include:

1. Patterns of value of older people as they are related to other age groups in society and to community patterns, covering, for example, perception of the available program by the participants and nonparticipants and relation of program to the status of the older adult.
2. Patterns of behavior, involving relation of the sexes in program participation, and levels of adjustment both in and outside the community, also the effects on adjustment through counseling of the older person and his family and of group living—in an institution and outside an institution—should be investigated.

3. Continual evaluation in order to improve programs by considering the changing facilities of the community and the capacities of the individual.
4. Positive knowledge about the capacities, abilities, and interests of older people, to determine how people can develop new skills and recreate former skills and thereby adjust to the community and remain contributing members of society.

*Methodology.* Particularly in this area, adequate attention should be given to the problems of sampling and statistical comparability. It is desirable to study all kinds of people in addition to certain restricted groups, such as residents of homes for the aged, hospitals, etc., who may be readily available for research. There should be systematic sampling of significant cultural and economic sub-groups in the population.

Data should be reported so that separate studies will be comparable. For instance, research procedures and sampling adequacy should be described and evaluated; standardization of age groups is recommended by semi-decades.

Methods for the measurement of intellectual-cognitive functions in the aging must be appraised. They should be supplemented by new methods which are appropriate for older people as such and which take into account the limits of their sensory capacities. Since most old people are not test-oriented as young people are, there must be an active consideration of techniques that will ensure their cooperation and also bring out pertinent answers.

The concept of functional intelligence must be broadened to include major aspects of social-adaptative behavior in relation to the ideas, things, and people in the environment. Included in this concept must be a recognition of the differential performances involving speed and power. The assessment devices must consider the relative importance of the physiologic changes in speed and sensory endowment and the maintenance of ability in the estimation of intellectual efficiency and deterioration. Emphasis should be placed on what old people can do as well as what they cannot do.

For all such measures, norms of performance for the general population at specified ages must be collected with adequate controls for background variables such as education, socio-economic status, and culture. There must be a recognition of the need for adequate statistical procedures so that the deviants can be understood against the so-called normal population.

### *Employment and Retirement*

One of the most prominent threads in the pattern of living is the day-to-day concern with gainful work. The significance of continuing employment for older people was shown by the consideration given to the subject by participants in three of the four Congress sections. The following paragraphs constitute a synthesis of their conclusions.

*Meaning of Work.* One conclusion was that work is essential in our society for practically everyone. It results in income for the individual and his family as well as a rising standard of living for all. Discussion of the psychologic meaning of work and retirement revealed that there are other considerations involved, such as the desire to work, maintenance of family and peer status, retention of social contacts, and possession of capacities and skills. Work was seen also as a factor in preserving physical and mental health. For the community and the nation, utilization of the work skills of all citizens is of basic economic and social importance.

*Evidence of Capacity.* Viewing employment in terms of ability of older persons to contribute profitably to an industrial or commercial organization, there was general agreement that there is no scientific basis for discrimination against older job applicants. It has been established in sales occupations, for example, that older workers are as capable as others. They made up for declines in physical strength, alertness, and perception by increased experience, responsibility, and loyalty. There are indications, based on foreign experience, that older workers can be feasibly employed in heavy industry under appropriate regimens, including organization into separate units. Preservation of health was seen as essential to continued employment, thus indicating the two-way relationship between health and work.

*Retirement.* It was agreed, too, that those who wish to retire after a lifetime of work and can retire should be free to do so. This is a freedom which should be preserved and extended. It was reported that the desire to retire diminishes as age 60 to 65 is approached and that retirement practices satisfactory for people who find one meaning in work may be unsatisfactory for others.

There was full recognition that chronologic age is not a satisfactory method of determining retirement; rather that retirement should be determined on the basis of individual capacity. Pending the development of objective criteria, evaluations should be based upon the combined judgment of management, labor, and medical personnel, taking into account the wishes of the worker. Successful experiments were reported.

*Retirement Preparation.* Reports on industrial practices revealed increasing awareness of responsibility for older workers through establishment of retirement plans, pre-retirement counseling, and post-retirement programs.

*Research Proposals.* In line with the discussions of employment, the following research and action program areas were outlined:

1. More information is needed on specific jobs suitable for older workers, methods of adapting jobs to the individual requirements of older

workers, methods of permitting women who have not recently been in the labor market to return to employment, methods of evaluating the productivity of older workers and the experience of specific firms and employers in making adaptations to insure employment of older workers.

2. Further studies should be encouraged on the meaning of work and on the causes of why individuals retire.
3. Special attention should be paid to disability as a cause of retirement and cooperation should be accelerated in working with physicians, personnel managers, rehabilitation specialists, and others in the early detection and care of disabilities and in offsetting effects of impairments in order to preserve work capacities.
4. Pilot studies should be made of the potentialities of progressive retirement.
5. Thorough investigation is needed on assessment of physical fitness, analysis of personality traits, and measurement of work capacity.
6. Extension of industrial health, medical, and social services to the retired worker aids post-retirement and health.

It was urged by all that more extensive exchange of information and experience of the various countries is desirable.

*Economics and Welfare*

The recognition that older people, in common with other groups in the population, must be able to live reasonably well, contribute to society's goods and wealth, and take part in community life was basic to the discussions in the section on economics, employment, and welfare. Starting from the fact that medical and biologic research and its applications indicated ever-increasing populations with larger numbers in the older age groups, the issues of concern dealt with quantitative aspects of the aging process, economic support of the aged through employment and otherwise, and individual and community problems. The experience of various countries of the world and contributions from various fields of learning and specialization were brought to bear on the definitions and solution of these questions.

An increase in the number and proportion of the aged is a characteristic of industrial societies throughout the world. As industrialism and urbanization have increased, economic and social problems of aging have also increased. The decline in the proportion of persons in agriculture and the increase in the proportion of persons in factory employment brings with it difficult problems of adjustment for the individual, for the family, and for society.

These problems of adjustment, however, are capable of being dealt with in an intelligent and orderly manner. We have developed many institutions and much experience, which clearly indicate that we have many tools to handle these problems. Social scientists along with the scientists in the medical and other fields have the responsibility of observing relevant experience and suggesting ways and means of adapting our present economic and social institutions to meet the needs of an aging population.

*Income Maintenance of the Aged and Disabled.* Important as is the matter of providing increased employment opportunities for older persons, it must be recognized that a very large proportion of older persons must be supported from sources other than earnings. This is evident from the fact that all of the major industrial countries in the world have adopted some program for providing income to aged persons, and practically all of them also have adopted some program for providing income for persons who are prematurely disabled for any gainful work. A number of other countries are considering the adoption of such plans or studying proposals for eventual introduction.

Many different plans exist which have been adapted to the particular conditions of each country. These plans are constantly being changed, improved, and broadened.

There has been extensive interchange of experience and ideas among the various countries in the world, but this interchange should be further encouraged and accelerated. Many countries do not have the specialized and professional personnel to put such plans into full operation. There is an urgent need for making available technical personnel to countries of evolving industrial importance.

Information on the relation of industrial and public pension plans should be systematically obtained. The effect of private pension plans on compulsory retirement and the mobility of workers should be carefully evaluated.

*Community Services and Community Organization.* In recent years there has been a vast growth in the many kinds of service available to all age groups in the population. Health services, social services, rehabilitation, education, housing, nursing and home care, and many other facilities and services are expanding and becoming more and more specialized. As specialization increases there is an urgent need for the effective coordination of these services into a unifying and workable whole.

In dealing with an individual we must consider the whole individual in relation to the whole community. It is as important to challenge the older person as well as to protect him. Organizing the whole community to serve the whole individual is a great task. All specialists must work together in this common effort.

Community organization is a specialty in itself. We need exchange of experience and an understanding of the tools to use to accomplish the objective of maximizing the resources of each and every com-

munity for the benefit of those who are aging. We need fuller recognition that many personal needs—such as companionship, communication, transportation—can be met on a neighborly basis through voluntary effort. There is a need for more intensive studies of all aspects of the economic, social, and other aspects of the aged in different communities. It was proposed that such studies be made in existing communities and in communities largely settled by them or established for them.

*Economic Implications and Costs.* Improvements in many different programs for the benefit of aged persons cost money. They involve expansion of facilities, personnel, and the training of personnel. Each country must decide, in view of its own situation and values, how much it can allocate for the aged. This involves difficult questions of priority of needs and balancing of conflicting interests.

Whatever is allocated for one group in the population must come out of the goods and services produced by the productive members of society. It is clear that there is a trend towards increasing the proportion of the national income which must be allocated to improve the standard of living for the aged, the sick, and the disabled. At the same time by increasing the productivity of the economy as a whole it will be possible to improve the standard of living for everyone.

A sound and progressive program of research, income maintenance, rehabilitation, and medical and other services for the aged can and should contribute to improving the economic well-being and happiness of the entire population. By initiating and improving such programs, excessive costs can be minimized and important social and humanitarian contributions can be achieved.

The economies of the various countries of the world are in various stages of evolution. Much more information is needed on comparative costs of programs, methods of investing funds to improve production and employment opportunities, tax provisions for aged persons working and retired, and the methods of distributing costs as well as their implications for a healthy and improving economy.

### *Health, Medical Care, and Housing*

Foremost among the problems of a world-wide aging population are those associated with personal and medical needs. Certainly, health is basic to a happy and productive later life. Just as certain, however, is the fact that nowhere on this earth are the health needs of older people being adequately met. This is equally true for housing and living arrangements, recreational and social needs, and the acceptance of older people in family and community life.

There are many elements which must be considered in a sound and comprehensive approach to meeting the health needs of the aging. Among these are adequate preparation for the period of later life, health maintenance and the prevention of disability, medical care and services for the sick and disabled aged, including therapeutic, institutional, and rehabilitative services, suitable housing and living arrangements, and safety. Health aspects of employment and retirement and community planning were discussed earlier.

A major objective in the discussion of these elements was, first, to identify action programs that can be undertaken in health promotion and care on the basis of what is already known, and secondly, to stimulate research in this field. It is clear that many areas are open for action, that existing knowledge can be put to work in an effective manner, and that health and welfare workers must give increasing attention to the needs of older people.

The approach in these considerations was essentially preventive, accepting the premise that many of the debilitating handicaps of later life may be mitigated or postponed. The emphasis was on retaining function and on conserving and utilizing capacity as long as possible. In this framework, accident prevention, housing and living arrangements, and even medical and rehabilitative services were viewed as constructive means for meeting well in advance the problems of aging individuals and an older population generally. The consensus was that these services should be instituted early to prevent further disability and that they should be dynamic rather than palliative: they must prepare older people either to continue or return to active roles in society.

One of the major themes that ran through all of the discussions was that older people must be participating members of society. The effect of this on older people's mental health and on their ability to recover from sickness and injury are incalculable. The trend in caring for older people is away from institutionalization and towards treatment in the home, on the job, and within the community. Where institutionalization is necessary, it should be therapeutic and rehabilitative rather than custodial.

*Preparation for Aging and Health Maintenance.* Our sights must be pointed to the day when the later years will in fact be a useful and rewarding part of life rather than a time of deterioration. To this end, we need planning and preparation.

The individual can do a great deal for himself if available knowledge about preventive measures is more widely disseminated to people of all ages. Both public and professional channels of education should be directed towards this end. However, these individual efforts must be reinforced and supplemented by organized efforts.

The community must play an active role in preparing people for later life and in preventing disability. In this field, the following points were also made:

1. There is need for amplified educational material on health guidance, which would bring together available knowledge in convenient form. This material should be disseminated widely, for use by the older person himself and by health counselors.
2. Thorough health examinations at significant periods in the lives of individuals plus more limited tests at frequent intervals are necessary to detect diseases or other significant deviations from the normal. Industry can play an important part in this by sponsoring health inventory programs, on an optional basis, for workers. Early detection and treatment of disease in its incipient stage affords one of the best preventives of premature aging and chronic impairments.
3. With a view to further development of such preventive measures, it was taken for granted that research on the basic causes of the disease and conditions which aggravate the aging process, and on aging patterns, successful and unsuccessful, as outlined in the section on biology and medicine will be continued.

*Medical Services and Care.* A great number of older people have already lost their health or have pronounced disabilities. Theirs is perhaps the most pressing as well as the most disturbing problem at the present time. Moreover, they represent a great problem numerically for organized society throughout the world. It was noted that older patients frequently suffer from polypathology and that various pathologic processes present are not necessarily all in the same advanced state and will not all respond equally well to therapy. This fact, however, must not be regarded as a bar to treatment; relief of symptoms even in one system is frequently followed by disproportionate improvement in general health and social adjustment. Treatment in the aged may take much longer than in other groups and may have to be undertaken at a much slower tempo. Nevertheless, methods must be found not only for meeting their immediate needs for adequate care but also for returning as many as possible to more active roles in society.

Among the suggestions developed for improving the status of these older people were:

1. Greater effort should be made to utilize the normal family environment in the care of older people. Various types of noninstitutional services such as clinics, guidance and counselling centers, home care programs and others should be strengthened. Interest in the health needs of older persons, incorporated into the thinking and practice of private physicians, public health agencies, and community organizations, as well as the promotion of better public understanding of the needs and problems of older people will help to attain this goal.
2. Techniques should be developed to give integration and continuity to the care of older people, both in institutions and in their homes. To this end, it is important to have effective cooperation among the various professions and agencies concerned.
3. There is great need for closer coordination among the acute general hospital, the long term hospital, the home for the aged, and the private or government-sponsored nursing home. Affiliation or a working relationship between these institutions should be encouraged. Care can then be continuous and progressive instead of static.
4. The home for the aged should be seen as one of a series of services. The goal should not be permanent residence for all who enter, but, wherever possible, rehabilitation for semi-independence in other settings.
5. Standards, dealing with basic principles rather than specific details, need to be established for nursing homes and other types of institutions for older people. Although some measure of public control is recognized as essential, voluntary efforts of nursing home operators themselves are of primary importance in raising standards and improving the quality of care.
6. It is important that physical medicine and rehabilitation services and recreational and diversional therapy be encouraged in all institutions caring for older people. With a greater awareness of the value of professional services, a more adequate number of trained personnel will be employed in homes, hospitals, and other agencies dealing with old people.
7. There is a need for additional rehabilitation centers, with properly trained staffs, to be established on a combined area and population basis.
8. Nutrition is a fruitful area for both preventive and rehabilitative measures. Many of the disorders and impairments of later years it is believed could be prevented or their effects mitigated by greater attention to the dietary habits of older people and to their specific nutritional needs.
9. In regard to the cost of constructing and equipping needed physical facilities for the health care of older persons, funds from all sources—individual, voluntary, and public—are required.
10. Voluntary and private insurance programs might be broadened to cover long term illness and disability, as well as persons in the older age group, now usually excluded.

*Social and Environmental Factors.* Adequate health and satisfaction in later life rests partly on attention to the personal needs of older people. But serious consideration must also be given to the environmental

factors which retard or accelerate the aging process. Both the physical and social environment must be assessed. In considering such topics as housing, living arrangements, accident prevention, and community planning, these major conclusions were reached:

1. A large number of older people want to live in their own households as long as possible. Every effort should be made to enable them to do so.
2. Housing and living arrangements must be planned around the concept that housing is a part of the total needs of older persons—personal, social, economic, and medical.
3. Because a high proportion of older people cannot meet current rentals, extensive basic changes are needed in new housing design, material, and construction in order to reduce costs and improve living standards. Moreover, because of their physiologic and psychologic needs, health and safety factors must be underscored in planning suitable housing arrangements for the aging. Both private builders and public housing authorities should be encouraged to produce more housing suitable for small families generally, and for older people, particularly.
4. Accidents in and about the home are a major cause of death and disability among the aged. Much can be done to prevent accidents in the home through education and redesign. Some things need to be studied in more detail, like habit patterns and emotional traits of aged individuals.
5. Many of the environmental factors which are hazardous for older people can be readily eliminated by the application of existing knowledge. Studies indicate that this can be done effectively by continuous community-wide safety programs under the leadership of official and professional agencies.

## III. Topical Summary

This section represents an effort to highlight the major points made in the various papers read or submitted during the Congress and also in the floor discussions which took place at section and panel meetings. Obviously, so brief a summary cannot hope to do anything like full justice to the wide range of ideas and factual data which characterized these papers and discussions.

### Section 1.

### *Biology and Medicine*

A total of approximately 238 papers were read in the various sessions of the Section on Biology and Medicine. Of these papers, approximately 25 per cent dealt with age changes in tissue structure and function, 10 per cent with problems of metabolism and nutrition, 15 per cent with functional capacities of various organ systems, and 55 per cent with problems of diseases and their treatment in older people.

*General.* Since aging is a property common to all animals, studies on different species may shed light on the nature of the process. Thus it was reported that in most species of animals the female outlives the male. In the mouse this difference amounts to 100 days (Rosahn),[3] or approximately one-sixth of the total life span. Thus far, the only species observed in which the male tends to outlive the female is the hamster (McCay). There are wide differences in the longevity of different species as well as differences in the pathologic changes which result in death. Thus the reptiles as a group are the longest lived of all vertebrates (Bourlière). Although it is often difficult to estimate the age at death of animal species living in their normal habitat, it has been possible to estimate the life span of the snake, since it was found that the bones of the skull of this species show "animal rings," similar to those found in trees. These rings are due to seasonal differences in growth rate (Bourlière). Contrary to the findings in mammals, snakes continue to grow throughout their life span with no diminution in fertility. Examination of the internal organs of old snakes failed to show any evidence of senile involution (Bourlière).

Even among mammals, different organ systems show widely different susceptibility to breakdown and to diseases that result in death. Thus the rat most frequently succumbs to lung diseases (tumors, bronchiectasis) whereas the dog is more resistant to lung disease (McCay). Although the rat frequently develops chronic ear disease, the closely related hamster does not (McCay). The aged mouse frequently shows structural changes in its arteries (Rosahn). The old male mouse also develops benign hyperplasia of the prostate, similar to that observed in the human (Rosahn). In view of the species differences in causes of death, the importance of additional detailed studies on many different species of animals was emphasized (McCay).

*Genetics.* The importance of inheritance in determining differences in longevity among animals of the same species was stressed. An analysis of the longevity of 18,000 males and females collected from Finnish and Swedish genealogies showed that the longevity of fathers had no effect on the longevity of their daughters. There was some effect on longevity of their sons, but it was of less importance than was longevity of the mother. It was also found that high maternal age at birth shortened the life expectancy of the children, whereas the age of the father had no effect (Jalavisto).

[3] More detailed abstracts of papers mentioned may be found under each author's name in the *Journal of Gerontology* 6, Supplement to No. 3, Oct. 1951.

Further evidence that inheritance characteristics may be influenced by factors outside of genes was also presented. Thus selective breeding experiments on the rotifer, where genetic composition can be held constant, showed that the longevity of animals derived from a single parent could be progressively lengthened or shortened by selecting long- or short-lived parents for successive generations. This indicates that a cytoplasmic factor is operative in aging (Lansing). Evidence for this concept was also found in the report that when successive generations of bacteria are subjected to unfavorable growth conditions (increased temperature) the species finally dies out. On the contrary, the same condition of high temperature, enhances population growth, vigor and survival if applied intermittently (Spencer and Melroy).

In the mouse it was found that the offspring of advanced litters do not show the same latent period and survival time of chemically induced tumors as do their parents. The changing trend during the life span of the individual and the fact that this trend is cumulative in successive generations means that transmission of these characteristics from parent to offspring must depend on factors outside of the genes themselves (Strong). This new evidence of the effects of the cytoplasm on inheritance emphasized the need for additional research on the genetic aspects of aging.

*Structural Changes: General.* With increasing age the body undergoes many structural changes. Some of these changes readily observed in humans include a gradual reduction in body height. Measurements on 800 negro and white cadavers showed that body height in both races and sexes diminished on the average 2 cm. per twenty years between the ages of 30 and 90 (Trotter and Gleser). The amount and rate of growth of axillary hair (Hamilton) and beard (Chieffi) also diminished with increasing age. Middle-aged men (age 50) matched for body weight with a group of 20 year olds showed a significantly larger amount of body fat than did the young subjects. This difference was apparent from measures of specific gravity of the body and by the thickness of skin folds in various parts of the body. It is concluded that muscle tissue is replaced by adipose tissue with increasing age (Brožek and Keys).

*Structural Changes: Heart and Blood Vessels.* The organs of the body also undergo structural changes. Some of these changes may be directly observed while others require microscopic examination. The caliber and number of blood vessels supplying the heart diminish in old age, but there is no close correlation with the electrocardiograms or clinical estimates of cardiac function. Many interconnections between the blood vessels of the heart were observed by taking x-ray photographs of hearts injected with radiopaque substances after death (Herbeuval, Saivre, Remy, and Sabiani). Four out of 5 hearts from women over the age of 80 years showed thickening of the valves with changes in microscopic structure (Geill and Kiær).

Studies on the thymus gland, which shows aging and involution towards the end of the growth period of the animal, illustrated the relationship of blood vessel changes to the involutional process. In the mouse the larger arteries and veins become tortuous and shortened with the deposition of adipose tissue in the gland (Smith, Kraemer, and Holt). Since the capillaries of the skin are more easily ruptured in old subjects than young, it is believed that the changes in the cellular structure of the blood vessels may be one of the physiopathologic factors in aging (Scarzella, Mars, and Morpurgo).

*Structural Changes: Skeleton.* Examination of 4200 skeletons aged 20 to 80 for the occurrence of structural changes in the spinal column failed to show any relationship between age and the incidence of separate neural arch, a condition found in 42 per cent of all skeletons examined (Roche and Rowe). The continued administration of growth hormone produced extremely dense and heavy bones in the rat, whereas the administration of thyroid hormone had no influence on growth rate but accelerated aging of the skeleton (Evans, Asling, and Simpson).

Microscopic examination of the bone marrow failed to demonstrate any marked age differences in function except for the presence of more plasmocytes and neoplastic cells in the old group (Herbeuval, Pierson, and Bassot).

*Structural Changes: Organs.* Guinea pigs living to 2578 days of age were sacrificed and their organs examined. There was a high incidence of hemorrhage, abcesses, and cysts in the kidney. When examined microscopically there was fatty infiltration of the cells of the tubules, disappearance of many glomerular tufts, and a marked thickening of the interlobular arteries (Rogers).

With advancing age there is a progressive increase in length of the colon and a decrease in the weight of the smooth muscle layers per unit of length (Kheim). The lungs of almost all old people show an increase in the number of air spaces in the lung, resulting in poorer ventilation of the lungs (Duguid and Rannie). With newer methods of diagnosis an increasing number of cases of atrophy of the cells of the brain have been found among older people, but the cause of the atrophy is unknown (Thompson and Mundorf).

*Structural Changes: Skin.* Microscopic examination of the skin shows that the thickness and volume of the epidermis decreases with advancing age (Thuringer and Katzberg). In addition, the number of cells per square millimeter of skin and their rate of division are significantly reduced (Cooper, Thuringer, and Katzberg).

*Structural Changes: Sense Organs.* Although no clear relationship between structural changes in the inner ear and hearing loss has been demonstrated (Covell), structural changes in the otic capsule were reported in 25 out of 38 cases that seemed to be related to hearing difficulties in the aged (Bast).

*Structural Changes: Cellular.* More detailed microscopic examination of individual cells from aged animals reported the accumulation of lipoid substances and other fats as well as specially staining pigments. Shrinkage and final replacement of living cells with fibrous and connective tissue was also reported in cells of both the central and peripheral nervous system. Some cells observed in parotid glands from old humans had lost all of their normal contents (Bauer). Other cells, such as those from the otic sac of the inner ear, showed the accumulation of cellular debris and a viscid colloid-like fluid (Bast).

Changes in constituents of the cytoplasm were also reported. Thus the mitochrondria of cells of the adrenal gland of the rat undergo degenerative changes and decrease in number (Jayne). Similar changes in the mitochrondia of cells from other organs including the liver, pancreas, kidney, submaxillary gland, and parotid glands were also reported. In the kidney, pancreas and liver the changes were confined to cells in small areas of the organs, suggesting that they were due to local pathologic conditions related to extrinsic factors such as sclerosis of the blood vessels (Kurtz and Andrew).

In a wide variety of organisms calcium accumulates characteristically in the region of the cell surface. Experimental removal of calcium tends to increase the life span. It was suggested that calcium is bound to ribo-nucleoprotein at all cell surfaces and that age changes in the latter are reflected in calcium binding (Lansing).

*Structural Changes: Nervous System.* It was also found that cells in different areas of the brain show different susceptibility to the accumulation of lipoid pigments (Wilcox). In the autonomic ganglia of man there is an increase in the number and size of the cells of the nonnervous supporting structures with a loss of nerve cells (Kuntz). Similarly there is an increase in the number of connective tissue cells in the sciatic nerve and brachial plexus of aged horses, dogs, and cats (Biester).

The use of special staining methods makes it possible to identify the chemical nature of some of the constituents of cells. Thus it was reported that the glycogen present in the autonomic ganglion cells of the young adult dog is replaced by more stable conjugated mucoproteins in the old animal. The amount of ascorbic acid (vitamin C) also diminishes in these cells in senile dogs (Sulkin).

*Structural Changes: Connective Tissue.* The chemical and physical properties of the connective tissue were reported and discussed in a symposium. Electro-microscope studies of elastin from skin and blood vessels showed that the coiled fibers present in elastin from young animals were replaced by strands that were frayed in nature and much less coiled (Tunbridge, Astbury, Reed, Hall, and Tattersall). The chemical composition of elastin from aortas of old animals showed an increase in specific gravity, calcium content, and altered amino acid composition when compared with young (Lansing).

The studies on structure of tissues and cells have given additional information that needs to be related to functional changes.

*Cellular Function.* Relatively few studies on age changes in cellular physiology and biochemistry were reported. In mouse brain homogenates the rate of oxygen utilization was lowest at birth, increasing up to the twentieth day. Morphine in high concentrations inhibits oxygen uptake and increases glycolysis in this preparation. The effect was greatest in young animals (less than 10 days of age) (Richer, Stern, and Birmingham).

It was also shown that the age of the animal has a marked influence on the tissue response to drugs and endocrine products (Silberberg and Silberberg). The acid phosphatase activity of mouse liver rises sharply after birth, reaching a peak at 15 to 20 days. Thereafter, there is a fall in actvity up to 1 month when it remains stable up to 17 months of age. There is thus no evidence of reduced activity of this important enzyme in the liver in later maturity (Zorzoli). In contrast to the popular belief that wounds of older people do not heal as well as those of younger subjects, no statistical difference in young and old rats could be found (Dalton, Lemmer, and Anschutz).

*Organ System Function.* With increasing age the effectiveness of most of the organs of the body undergoes changes. In many instances the degree and extent of these changes have not been adequately described. Many of the tests used for diagnostic purposes are based on the performances of young adults. Thus, the electroencephalogram, useful in the diagnosis of changes in the brain, has not been recorded in adequate numbers of normal aged people (O'Leary and Lam). Preliminary results showed that the electroencephalogram records of older subjects became more like those obtained in children, i.e., the rhythm shown was slower than in young adults. There was also a greater incidence of atypical patterns (Obrist).

Similarly, there is inadequate normal data on the electrocardiogram in old people. Some changes, regarded as an index of heart disease in young people, appear as early as age 55 in the absence of other signs of heart disease (Simonson and Keys). There was a decrease in the voltages recorded and an increase in the time required for conduction of the wave of contraction from auricle to ventricle (Simonson and Keys; Harkin and Beber). Furthermore,

alterations in the form of the electrocardiogram in old people may be induced by postural maneuvers which alter the position of the heart within the chest (Olbrich).

Fainting in old people is usually conditioned by arteriosclerosis and cardiac decompensaton (Vega-Diaz). With increasing age there is a progressive reduction in the ability of the tubule of the kidney to resorb glucose. Since the glomerular filtration rate is reduced proportionately, the urine continues to be sugar-free under normal circumstances (Miller, McDonald, and Shock). The reduction in muscular strength that accompanies aging cannot be entirely accounted for on the basis of anatomic involution of the muscles of the body. The fatigability of specific muscular groups also increases in advanced age (Binet and Bourlière).

Although the number of red blood cells in the circulation diminishes slightly with age there is no indication of any striking changes in peripheral blood or the bone marrow in old people (Shapleigh, Mayes, and Moore). The distribution of proteins in the blood serum shifts with advancing age, i.e., there is an increase in the globulin fraction and a decrease in the albumen. There is also a marked increase in the ratio of carbohydrate to nitrogen in the albumen fraction (Vanzetti, Mars, and Formiga-Orazi).

There is a small but significant diminution in the amount of blood pumped by the heart between the ages of 20 and 55 years (Taylor, Brožek, and Keys).

*Endocrines.* Traditionally the endocrine, and particularly the sex glands, have been regarded as having an important bearing on aging in the human. The urinary excretion of male sex hormone diminishes with age (Pincus, Romanoff, and Carlo). The administration of male sex hormone (testosterone) was recommended by some investigators, particularly in the treatment of symptoms of the male climacteric (Commons; Goldzieher and Goldzieher; McGavack). However the diagnosis of the male climacteric remains difficult since the condition is not always associated with increased excretion of gonadotrophic hormone (Goldzieher and Goldzieher; Heller and Shipley). The administration of sex hormones is not without hazard in males, since the hormones may produce undesirable side effects, such as hypertrophy of the prostate gland.

It is very doubtful whether testicular deficiency can be regarded as a basic cause of aging. It is more probable that the senile deterioration of the gonads is similar to the deterioration observed in other tissues. Thus the administration of male sex hormones to senile male rats gave only weak anti-aging effects, whereas in aged castrate (male) rats the effects were marked (Korenchevsky).

In the aged female, administration of female sex hormones will stimulate the uterus and vagina to go through the same changes as occur in the course of menstruation. However the duration and intensity of the response to a given dose level diminishes with increasing age (Shearman, Vogel, and McGavack). Continued administration of female sex hormones (estrogens) to aged women resulted in structural changes in the blood vessels of the pelvis and uterus. Some of the blood vessels of the uterus showed evidence of recanalization of previously thrombosed and sclerotic vessels (Masters).

The administration of male and female sex hormones produce observable changes in the nasal mucosa which may prove of value in determining proper dosage levels to be given in individual cases (Votaw).

Conflicting reports were given with regard to age changes in the activity of the thyroid gland, which influences the level of metabolic activity of the body. It was pointed out that the basal metabolism of the body declines only about 10 per cent between the ages of 30 and 80 and that the amount of protein bound iodine in the plasma is not changed with age. One investigator also reported no change in the rate of uptake of iodine by the thyroid gland with age (Starr). It was also reported that the rate of uptake of iodine was low in many aged individuals and that beneficial results were often obtained by the administration of thyroid hormone (Hashinger).

The adrenal glands play an important role in the reaction of the body to many stresses, such as increased temperature, dietary alterations, surgical trauma, infection, etc. The adaptation to stress is slower in old subjects than in young. Thus, when the sodium intake in the diet was reduced, a period of two to three weeks was required for adjustment of the urinary excretion of sodium in aged subjects, whereas in young adults adjustment was effected in forty-eight hours. In young subjects, restriction of sodium intake had no effect on the sodium content of the blood, but in aged subjects there was a reduction in blood sodium levels (Thomson). Since sodium metabolism is influenced by hormones secreted by the adrenal cortex, it was believed that these experiments offered evidence of impaired adrenal function in the aged.

Other evidence of impaired adrenal function is offered by the reduction in urinary excretion of 17-ketosteroids with increasing age (Heller and Shipley; Pincus, Romanoff, and Carlo). However, excretion of other hormones of the adrenal cortex (neutral reducing lipids and 11-oxysteroids) did not diminish significantly with age (Pincus, Romanoff, and Carlo; Heller and Shipley). It was also reported that the response of the adrenal glands to a physiologic stimulus (ACTH) was diminished in old age (Freeman, Elmadjian, Pincus, and Romanoff).

Since many of the endocrine glands (ovary, testis, thyroid, and adrenal) are influenced by hormones secreted by the anterior pituitary, it is possible that the primary endocrine changes associated with aging

are due to impairment of the pituitary. Although structural changes in the pituitary have been observed with increasing age (Pañella-Casas and Monteys-Porta) bioassays failed to show any diminution in adreno- or thyrotropic hormone content in pituitary glands from aged humans (Blumenthal).

It is thus apparent that more research on the endocrine aspects of aging is required.

*Nutrition.* Studies on nutrition revealed the favorable effects of diets low in calories, but adequate in essential proteins, on one-celled animals as well as humans. Well fed *Tokophyra infusionum* have a higher reproductive rate than those on restricted diets or those overfed, and those kept on a meager diet or starved intermittently have a longer life (Rudzinska). In rats, as overnutrition promotes senility, it may impair reproduction by decreasing the possibility of rejuvenation (Carlson and Hoelzel).

There is little change in the chemical composition of the overall carcass of the normally fed and calorie restricted mouse, except a decrease in fat. There is a nitrogen percentage decrease at 18 months of age, which is greater for the calorie underfed mouse. An increase in sodium indicates a relative increase in extracellular fluid space with age (Visscher and King).

In human diets, adequate amounts of protein in breakfast result in higher and longer maintained blood sugar levels. Fasting blood sugar levels are higher in older persons than in the young (Tuttle). Heat production following ingestion of a food combination with a protein content of 25 gm. was found to be more variable in old persons than in the young (Horvath and Tuttle). On the other hand, on the basis of the measurement of nitrogen metabolism, blood protein levels, and basal metabolic rates of 97 normal old men and women, caloric and protein requirements of the old seem to be 30 per cent lower than recommended by the Food and Nutrition Board of the National Research Council (Albanese and Higgons).

Most old people are found to be in negative nitrogen balance on a protein intake of less than 1 gm. per kilogram of body weight per day. Cortisone and thyroid cause negative balance temporarily until an increase in appetite improves food intake (Kountz).

Retentions of nitrogen and phosphorous in 18 women 48 to 77 years of age increased with intake although variations in individual response was wider than in younger women (Ohlson, Jackson, Marin, Dunsing, and Brewer).

In chronically hospitalized patients, there was found a higher percentage of osteoporosis in patients with an intake of calcium below 500 mg. per day and an intake of phosphorus below 900 mg. per day, emphasizing the dietary factor in senile osteoporosis (Vinther-Paulsen).

A dietary for institutional use was discussed, based on the use of dry milk solids, soy flour, grits, wheat germ, and brewer's yeast (Flack) and a diet moderate in caloric intake, consisting of liberal amounts of ascorbic acid, water, unless a heart condition contraindicates; reduction in fats; vegetables; and moderate amounts of alcohol was suggested for the elderly (Alessandrini).

*Disease Processes: Cancer.* Widely differing views on the relationship of cancer and the aging process were reported. Statistically, there is apparently a rapid increase in the rate at which new cancers develop in the later half of life, when the incidence of cancer is 200 times greater than in the early years. The rate of increase for females is greater in the early years, although the male rate begins to increase at age 40 and by 65 is greater than that of females (Dorn and Firket). A predisposition to cancer in old age was reported, although the promoting factor becomes active before visible onset of age (v. Albertini). Removal of the mammary tumor agent in mice increases the life span and allows for the development of tumors of other organs (Dunn).

On the other hand, it was stated that cancer does not exhibit any differences in age distribution and cancers of different organs have marked variations in their age peaks of frequency which cannot be related to differences in the speed of aging of the organ (Hueper). Experimentally tumors are as easily if not more readily produced in young animals than old ones. Wide variations have been found in the age at which tumors develop in the Wellesley C$_3$H strain of mice (Jones). Variations in the clinical course of cancer in patients with similar types of disease suggest host and/or tumor factors which are influenced by environment, some of which may be related to aging (Klopp).

In studies of Rous sarcoma in fowl, alterations in the serum protein pattern were noted in the presence of malignancy, while in normal growth there is an increase in the concentration of serum protein (Parfentjev and Duran-Reynals). The natural history of avian cancer follows a course of early infection in the immature host, a period of latency, and the development of a cancer virus capable of inducing a variety of tumors when the host reaches a "cancer age" (Duran-Reynals and Briody).

Tumors in senile animals were reported. Ten cases in 160 guinea pigs, 1095 days and older (Rogers) and 8 cases of primary adenocarcinomas of the thyroid in dogs with an average age of 12.5 years, the youngest being 10 (Martin). Changes ranging from slight thickening to actual tumefaction were found in the meninges of cats over 10 years of age (Martin).

In discussions of treatment, it was urged that since cancer plays an important role in women over 50, immediate biopsy is indicated when a single dominant lump is detected in an older woman's breast (Davis).

Various types of surgical and endocrine therapy were discussed for the treatment of patients with carcinoma of the prostate (Flocks). Since cancer in age has such characteristics as a slow rate of malignancy, its detection and control is easier in the old than in the young (Millan).

*Disease Processes: Gynecology.* The use of hormones in the treatment of menopausal symptoms was discussed in relation to the control of bleeding at menopause (Allen) and in the control of a syndrome which has often been believed to be simply an exaggeration of existing nervous conditions (Greenblatt). Arthritis and back pains occurring in women during the menopause have also been treated successfully with estrogens (Greenblatt). It has been found that estrogens and androgens release the luteinizing factor from the pituitaries and have an alleviating effect on severe vasomotor symptoms of the menopause. Likewise pituitary extracts containing the luteinizing factor have been found to control vasomotor symptoms in oophorectomized women (Hellbaum).

*Disease Processes: Bone and Joint Diseases.* A number of bone and joint conditions have been found to be present in old age. Diffuse alveolar atrophy of the jaw was found to be present in 24 cases in connection with presenile osteoporosis of the spine, suggesting that both diseases are manifestations of the same pathologic condition and apparently the result of prolonged calcium undernutrition (Groen, Duyvensz, Reisel, and Halstead). Stiff painful shoulder was found in 78 cases of individuals over 40, with most cases between 50 and 70 years of age (Meulengracht and Schwartz). A symptom complex accompanying idiopathic symmetrical hyperostosis of the skull was found to be frequent in women, particularly in the insane (Moore).

In the treatment of bone and joint disease a new extract from pregnant mammalian liver was found to reverse the syndrome of hypertrophic osteoarthritis as well as the syndrome of peripheral neuropathy in diabetics and nondiabetics, although it has questionable effect on rheumatoid arthritis (Collens, Zilinsky, Greenwald, and Stern). Steroid compounds and nutritional agents, in addition to the prevention of stress, trauma, and fatigue were recommended for the management of degenerative arthritis (Ishmael).

No differences were found in the electromyograms of rheumatoid arthritis patients treated with ACTH and cortisone as compared with untreated patients. It was found that there is electrical quiescence when the patient is at rest and the limbs are relaxed and properly positioned and tremorous activity on active motion (Mueller and Mead).

*Disease Processes: Rehabilitation.* More than medical aid is needed for rehabilitation of the older age groups and the aid of such ancillary specialists as physiatrists and social workers should be enlisted (Dacso).

Cardiac patients in the sixth and seventh decades can enter into and remain in useful employment through the application of selective placement techniques and with a reasonable amount of medical supervision (Goldwater and Bronstein), and much can be done to return the victim of cerebral accident to useful life through active physical rehabilitation and attention to morale (Warren).

The value of nutritional therapy in rehabilitation was pointed out in the use of niacinamide supplemental to the patient's diet in the treatment of stiff joints (Kaufman) and in a polyphasic regime consisting of antibiotics in connection with hormones, vitamins, and special diets (Perlman).

*Disease Processes: Arteriosclerosis.* Comparisons of old and young victims of coronary artery disease revealed that in the young there is a familial occurrence; more males are victims, but there is a higher incidence of obesity in females (Adlersberg, Zak, and Helpern). The influence of diets high in animal fats upon arteriosclerosis was widely reported (Groen, Kamminga, Tjiong, and Willebrands; Greppi, Mininni, and Scardigli). The decrease in mortality from arteriosclerosis in Sweden during periods of food restriction was noted (Henschen). However, it was found that the phospholipid-total cholesterol ratio is not significant as an index of atherosclerosis (Jackson and Wilkinson). Disorders in protein metabolism were believed to be of significance in providing evidence for the existence of plethoric diseases—arteriosclerosis, coronary insufficiency, diabetes, obesity, and gout (Scardigli, Salvini, and Grandonico). A correlation between arteriosclerosis and iodine deficiency was noted (Dungal).

Lumbar sympathectomy was advised in the treatment of arteriosclerosis obliterans (Costello and Edwards) and the use of nicotinamide in cerebral arteriosclerosis was suggested, since there is a resemblance between this disease and the mental symptoms of pellagra (Fleetwood).

With respect to the sclerotic process it was found that the age factor is of indirect importance (Walsh and Jensen; v. Albertini). It was generally found that there is a relationship between vascular changes and hypercholesterolemia (Johansson; Mininni, Capelli, and Checchia; Leary; Pomeranze; Szanto, Nelson, Ivy, and Popper) although in one case lipid deposition was considered a secondary phenomenon and not an essential part of arteriosclerotic process (Rinehart, Moon, and Greenberg).

Sclerosis and renin secretion were found to be dependent upon overaction of hypophysial eosinophile cell-adrenal renin hormone factors and underaction of hypophysial basophile cell-thyroid ovarian follicle and seminiferous tubule cell hormone factors (Heinbecker). Dedifferentiation, metaplasia, and inductive

powers of endothelium play a role in mural changes of aging vessels (Altschul). Arteriosclerotic plaque formation in experimental rabbits was found most frequently at the orifice of a branching vessel (Taylor).

*Disease Processes: Coronary Artery Disease.* The potential candidate for coronary heart disease was described as a person with a history of heart disease in his family; strong goal directed drives; short stature, though not necessarily heavier than normal; high cholesterol level (Gertler).

Persons over 45 years of age were found to comprise more than one-third of the instances of acute endocarditis in 14,000 autopsies in Cook County Hospital (Traut, Carter, and Gumbiner). Various steroids were found to have an effect upon the human heart (Friedlander and Perlman).

*Disease Processes: Surgery and Anesthesia.* Age is not a contraindication for surgery. However, special attention should be given to preoperative and postoperative care of patients. Chronic infection and anemias should be cleared up (Foldes) and if necessary suitable nutrients administered parenterally (Rice; Ziffren). Preoperative determination of blood volume and replacement of deficit is advised (Beling, Bosch, and Carter). Good results in gastric surgery are obtained by attention to maintenance of the patient's physical activity and physiologic equilibrium throughout the preoperative, operative and postoperative phases of his therapeutic regime (Potter, Andersen, and Stewart). Early diagnosis and prompt surgical relief were advised in cases of acute intestinal obstruction (Robinson; Cutler), acute appendicitis (Carp and Arminio), cholelithiasis (Fisher), and genito-urinary tract diseases (Thompson). Circulatory and respiratory defects should be determined in order to know what anesthesia should be administered. The safest may be a spinal or a general anesthesia (Morch and Lorhan). No satisfactory operation has been devised for surgical treatment of degenerative arthritis of the hip in the aged (Reynolds and Key).

*Disease Processes: Respiratory Disease.* The high incidence of bronchiectasis and chronic bronchitis (Sweet) and tuberculosis (Myers) in the aged were pointed out. ACTH was found to cause a shift in the reaction of pulmonary mucus in status asthmaticus to permit its reabsorption by the blood or inhibit its formation (Stanley, Shetlar, Bozalis, Huff, Cushing, Annadown, and Cawley).

*Disease Processes: Nervous and Mental Diseases.* The majority of mental diseases in old age seem to be functional rather than organic (Robinson and DeMott). A direct correlation was found between electroencephalographic abnormality and the degree of organic mental impairment in elderly patients (Luce and Rothschild). Analysis of differential psychosis rates for co-twins, siblings, and parents indicates that there is a genetic factor involved (Kallmann). Electric shock therapy for mental patients suffering from severe osteoporosis or osteomalacia has been made possible by the development of a technique of complete curarization (Gottlieb and Morris). It was found, in the study of a 106 year old man, that the psychologic resources and adaptability of an individual play an important role in not only maintaining equilibrium in face of aging but in resisting the onset of dementia (Schuster). The age factor in the incidence of certain neurotropic virus infections was noted in the St. Louis encephalitis epidemic (Brown). A new liver extract has been found to cause complete disappearance of urinary signs in cases of diabetic "cord bladder" and relief from pain and from limitation of motion of the extremities in cases of neuritis (Rabinowitch).

*Disease Processes: Neuromuscular Disease.* New concepts of the pattern and organization of the extrapyramidal system are believed to be among the most significant advances of neurophysiology (Unna and Vernier). Improvement in cases of Parkinson's Disease were noted following treatment with combinations of Benadryl and Rabellon and P-19 (dimethyl amino ethyl alpha, alpha-diphenylopropri-onate hydrochloride) and MK-02 (tropine benzohydryl ether methane sulfonate) (Tanaka and Edwards).

*Disease Processes: Diabetes.* A reduction of cholesterol concentration, moderate reduction of elevated blood pressure, improvement of renal function, slight improvement of vision and development of euphoria resulted from the use of lipocaic in cases of diabetes complicated by hypertension and atherosclerosis (Andreani and Mininni).

*Disease Processes: Urologic Disease.* In the geriatric management of prostatism, a clear picture of the urologic status may be obtained by intravenous pyelogram (Rose). Transurethral resection was advised as the operation of choice for the average case of prostatism (Creevy) and cystotomy drainage for the management of vesical decompensation (Nesbit and Baum). Pain subsided, ulcer disappeared, and the measured bladder capacity increased following administration of ACTH in 3 cases of chronic interstitial cystitis (Paquin and Marshall). Urinary stress incontinence in the healthy female was reported as a sequela of senility that is not commonly considered (Lich) and most cases seem to have disturbances of the mechanism used for voluntary inhibition of urination (Huffman and Sokol).

*Disease Processes: Hormone Treatment.* Favorable results were reported following the use of various steroid substances in aged and debilitated individuals (Homburger, Fishman, Bonner, and Dart) but indiscriminate use of testosterone propionate is to be condemned, as some permanent testicular damage might result (Cordonnier). Beneficial effects of ACTH and cortisone were reported for arthritis,

Addison's disease, and asthma and encouraging results in ulcerative colitis, regional enteritis, nephrotic syndrome (Thompson).

*Disease Processes: Hypertension.* The condition termed hypertensive nephrosclerosis in man may not necessarily signify a primary vascular disorder, but may arise as the result of a primary tubular degeneration in the kidney (Duguid and Rannie). In hypertension induced in the rat by removal of one kidney and constriction of the other, the cortex of the adrenal gland doubles or triples in size, but the medulla increases five fold (Rather). The adrenal cortex functions on several different levels in the hypertensive syndrome, not as a primary initiating factor, but as an essential link in the chain of factors which regulate peripheral vascular homeostasis (Zweifach). Any hindrance to the normal growth of the kidneys or to the compensatory hypertrophy of the remaining kidney after unilateral nephrectomy will cause hypertension (Braun-Menendez). Arteriolar changes may be the cause as well as the consequence of hypertensive cardiovascular disease (Grollman).

It has been demonstrated that there is a cellular, and presumably enzymatic lesion in a specific segment of the kidney tubules in experimental renal and human essential hypertension which may be related to the associated metabolic defect in renal VEM metabolism in hypertension (Shorr). The typical arterial lesion produced by a high fat diet and the induction of renal insufficiency constitutes a classical example of so-called collagen disease lesion related only to diet and renal insufficiency (Holman). A positive correlation has been found between the size of the Golgi apparatus of the pars recta cells of the proximal tubule and the plasma VEM level, suggesting that if the size of the Golgi apparatus is an indication of secretory activity, the cells of the pars recta may be the source of VEM (Dunihue).

Pherentasin, a pressor amine containing a carbonyl group, has been found in the blood of hypertensive patients (Schroeder), but no correlation has been found between the height of the blood pressure and the units of pherentasin estimated present in the arterial blood of hypertensives (Davies and Schroeder). Pressor efficiency of infused norepinephrine and epinephrine is enhanced after pretreatment with DCA, although the pressor effect of these catecholamines is weakened during sodium withdrawal (Raab). It has also been found that the material which elicits sustained pressor responses in nephrectomized animals is released when there is a diminished blood flow and/or diminished blood pressure in the kidneys (Helmer).

The physiologically important pressure is the mean blood pressure which the cuff method does not record. The severity of vascular disease bears no relation to the height of the blood pressure (Dexter).

In terms of treatment, it was reported that ascorbic acid brings to normal hypertension caused by long exposure to cold, excess of NaCl in diet, renal compression, and injection of desoxycorticosterone acetate (Héroux and Dugal). Vitamin E was found to bring relief of ocular symptoms in cases of arteriosclerotic and hypertensive retinopathy (Mars, Seidenari, and Morpurgo). A low protein diet, resulting in diminished secretion of ACTH, was found to abolish hypertension induced by sub-total nephrectomy in the rat (Handler and Bernheim).

## Section 2.

### *Sociology, Psychology, Education, and Religion*

Within this area, primary attention was devoted to the social roles of individuals and groups, with emphasis on personal psychologic development and on group attitudes. Here there were explorations into the problems experienced by people as they grew older in terms of social adjustment, employment, and opportunity for cultural development. Also considered were group and community problems in accepting and utilizing older people. Uppermost in all discussions was the recognition of the need for additional research to uncover facts and establish principles with appreciation of the great contribution of other disciplines to psychologic, social, and educational aspects of gerontology.

*Psychologic and Related Processes*

The slow decline of mental ability with increasing age was confirmed on the basis of intelligence test scores from maturity through old age. Mental power, however, holds up better than speed, rates of decline varying with the capacity measured. It is likely that the decreases in ability noted result from physical rather than over-all deterioration (Kleemeier).

Contrast and similarity between psychologic and physiologic change as a counterpart of aging was sought in a study of verbal fluency, in an attempt to discover which elements are responsible for mental performance (Birren and Botwinick). Somewhat at variance with Kleemeier's conclusions, Birren's data suggest that older individuals demonstrate slower responses in thought processes than might be expected on the basis of motor ability. There may be defects in thought arising from a low rate of association. Similarly, results yielded by a group of older persons subjected to a primary mental abilities test battery which permits analysis of six mental factors as verbal meaning, word fluency, and reasoning indicate a general steady deterioration of mental capacity with age (Schaie, Rosenthal, and Perlman). Differences between younger adults (20 to 34 and 35 to 49) and older adults (50 and over) were manifest in an inquiry into the effect of emotion (Blake). Utilizing the pulse rate (circulatory system) as indicator, the

effect of unannounced examinations was ascertained. The oldest group was apparently less affected than the other two, and the middle group most stimulated and upset. Based on psychologic studies, the thesis was confirmed that older adults (40 to 60), although reacting readily to intellectual stimuli, carry out reproductions of patterned tasks more slowly and remember recent happenings less fully than younger adults (van der Horst).

Attention, however, was also given to the similarities between the aged and other groups. It was noted, for instance, that the periods of adolescence and senescence are both becoming longer. Problems of dependency, employability, body change, acquisition and maintenance of social status, and conflict with other family members are significant for both, although admittedly in different degree and from different points of view (Brieland).

Throughout the discussions on characteristics of the aged, there was some suggestion that those who survive beyond 75 are mentally superior to those who, on the average, die in the 60 to 75 span. This proposition was most strikingly stated by authors of continuing studies on American centenarians (Dunbar and Dunbar). Those who survive the perilous years of 50 to 75 are a superior group, mentally and physically, and do not thereafter decline significantly in mental power.

*Personality Development Among the Aged*

Personality studies of institutionalized older people, utilizing Rorschach tests, indicated generally low mental productivity in comparison to average adults (Grossman, Warshawsky, and Hertz). Interests, thinking, creative capacity, and emotional outlets are limited and rigid. Yet, there is still a strong core of healthy and well-integrated personality development evident among older people. Rorschach performance of 100 institutionalized elderly men, for instance, indicated lesser statistical contrast between the 65 to 70 and 75 to 80 age groups than expected. The pattern of responses of the older age group resembled that of younger adults (Kuhlen and Keil). Sociologic, psychologic, and pathologic reports on inmates of a Swiss institution in which the older patients are given an opportunity to work show that they are capable of good adjustment, but have a tendency to introversion, regarding the home as a refuge (Vischer).

In considering personality development within a social environment, the characteristics of older people as affected by the community and family were analyzed. The attitudes of others towards older people likewise were examined. A clear pattern of emerging responsibility and activity during early adulthood and general maintenance of such activity is followed by restriction of life activity in terms of family size, employment, and income; and still later, in civil and political interest and organizational activity (Kuhler and Keil). Age at which decline sets in is related to initiative and energy involved in the activity.

With aging, there is a development of regressive tendencies, rigidity, and exclusion of external stimuli representing conscious resistance to an unsympathetic environment and to processes that imply decline and deterioration in physical power and social status (Weinberg). The psychotic personality, at least, may be built around the conflict with age. These considerations are important, the group believed, in creating a conceptual framework for preventive mental hygiene in later maturity.

*The Environment of the Aged*

Attitudes of the community, reflected in the status of the aged and their ability to contribute, were studied and reported by several investigators from the point of view of personality development and adjustment to later life. A questionnaire survey of a group of college and professional people indicated no significant difference among age groups in their judgment of older persons on selected personal traits, such as rigidity, dominance, optimism, humor (Chandler). On the other hand, a similar survey of a cross section of population of a typical industrial community indicated greater prejudice against older persons by the older group and, more so, by those who were apt to have stereotyped ideas concerning racial and ethnic groups (Barron).

The thesis that historically and throughout the world all societies maintain a "negative attitude towards the elderly" was expounded (Ginzberg). The attitude was demonstrated in several cultures; although not always apparent, it operates as an inner motivation. Determination of attitudes, it was agreed, and construction of the entire concept could be obtained from anthropologic as well as clinical studies. The social status of the aged of different racial groups may be evaluated by the anthropologist in relation to prevailing culture (Bergman).

*Participation by the Aged*

It was generally agreed that older people should be encouraged to take part in social, cultural, and civic activities, thereby contributing to the community. At the same time, it was believed that community facilities in recreational and educational spheres should be opened to them and adapted to their needs. Institutional existence for older people removes them from life's opportunities and responsibilities and frequently condemns them to a long period of inactivity. At this time, however, the old age home, whether public or denominational, may well assist the individual in making appropriate adjustment to later life if there are activities and facilities which are adapted to the desires of older people (Tarrell).

*Role of Religion*

Pastoral counseling for the aged was noted as a significant activity of the church. The minister was described as a friend who could assist the older person in working out his own problems and helping him obtain the counsel of physicians, psychiatrists, psychologists, and social workers. The minister can help best by becoming part of a community team (Tilden). Commenting on the fact that churches and synagogues have traditionally cared for older people, the modern synagogue was characterized as both a place of worship and study and a refuge. The physical and social facilities of a synagogue permit the aged to express capacities for enjoying later years, providing them with an opportunity to recall the past and look forward to the future (Biller). A second point of view described the church as directing its efforts towards helping older persons retain their independence and maintain relationships with family and friends and members of a broader community (Mother M. Bernadette de Lourdes). Continuing this concept, there was a plea for greater cooperation among churches of various faiths and between churches and labor unions, fraternity groups, and the professions in serving older persons.

*Recreation*

There is a growing recognition of the contribution of recreational activity in meeting the physical and social needs of older people. For the most part, although certain aspects have greater appeal than others, the basic principles in supplying recreational services to other groups are applicable to the older people (Bowen). Given an opportunity, older people will accept initiative and maintain responsibility for conducting and managing recreational programs.

Several community programs affording recreational outlets to older people were described (Laue; Vickery; Swartz). Emphasis, however, was given to the steps which must be taken by a community in planning for and establishing a set of activities which will meet the needs of older people. Planning begins when an agency or an individual calls together a representative group of the recreational resources of the community (Laue). The reports on community planning uniformly stress the need for a qualified staff. In developing club programs, it is essential to determine the extent of diversification available, depending upon the skill of the leader, group interests, nature of the environment and available resources in the community (Vickery).

The need for specialized personnel to understand the circumstances of older people and undertake activities on their behalf is evident not only in community and welfare work but also in institutional situations. There is need for the application of social work disciplines while the individual is in the community, during a transition period before entering the home, and while he is adjusting to it (Tarrell). A recreational facility which has immense possibilities is the provision of summer camping for older people. In addition to the benefits arising from change from humdrum routine existence, camping permits the use of group work techniques and satisfying social activities with persons of similar age and interests (Landau).

*Education for the Later Years*

In recognition of the earnest need for training and preparation for the older years, several outstanding regular courses have been developed by colleges and universities. Outstanding are the courses given by the University of Chicago's Committee on Human Development and the University of Michigan's Institute for Human Adjustment. The Chicago course includes counseling discussion, and a varied course centering on health, employment, financial planning, use of leisure time, community and social participation, spiritual values, and an understanding of the physical and psychologic changes which accompany aging (Little). At Michigan, the extension of educational facilities to the aging has concentrated on teaching older people how to solve their own problems through project undertakings as well as formal instruction (Donahue). Both universities have employed visual aids, recordings, radio, newspapers, and other effective devices. The university has a responsibility not only for expanding facilities to older people but also to those who wish to become adult educators (Reals). Its influence can reach far if it trains leaders, undertakes research, and disseminates information through many channels.

More and more communities are making educational facilities available, offering courses to adults mainly as adjuncts to secondary education and as extension courses. Large cities, as expected, have been making considerable progress in this direction. Los Angeles has recently sponsored a program specifically designed for men and women age 60 and over (Barron). Program objectives look towards establishing broader interests, conveying understanding of changes occurring in the later years, supplying social opportunity, and generally transmitting recent research findings. In New York, the State Education Department is seeking new ways to meet the needs of its population of 1,285,000 of individuals 65 years of age and older (Rabe). Public school doors are opened to adults, especially to the community groups to which they belong. The traditional night school program is being revamped to satisfy new conditions and to utilize new techniques of instruction, frequently outside the school itself and in homes for the aged, pensioners' clubs, unions, and in industry (Rabe). In Philadelphia the Recreation Association initiated a leisure time program in 3 counties for aged people. Planned recreational and educational activities dem-

onstrate what a community can do to engage the minds and interests of older groups and encourage them to devote their skills to community projects (Bowen).

*The Social Environment and the Community*

Studies of the individual in relation to social environment were considered of utmost importance. Reports of adjustment to community activity and to group programs (Schwartz; Kaplan; Albrecht) and, on the other hand, institution of programs by communities for older people (Laue; Vickery; Landau) were presented. In a society which is changing rapidly, the interaction between social conditions and specific population groups must be understood. Illustrative of such inquiries was a study of health of older people in relation to social factors to determine the extent to which the aged suffer from physical handicaps and how such conditions influence social participation and various status factors (Albrecht). Reviewing a hundred people over 65 in this light it was found that about one-fifth indicated they were in good health,—that is to say, they did not have problems of hearing, vision, use of lower limbs and arms, the handicaps most frequently reported by those indicating poor health.

Social status differences favored people in comfortable economic circumstances. Good health did not guarantee high activity, good adjustment, or youthful personality but handicaps generally were related to low activity and low adjustment (Albrecht). A British study, extending over a decade, of old people in home and employment situations, in institutions and hospitals, at work and in retirement, stresses the need for developing preventive programs and for patience rather than simply ameliorating current distress situations (Burstein).

The approach of psycho-social research attempting to reach into the personality of the individual by utilizing discussions with either groups or individuals has much to offer. The theory of motivation, also suggested, promises another fruitful approach to study of problems of aging. In this view successful aging is only an aspect of the more general problem of following both physical and the higher drives towards truth and moral values of self-realization (Paulus). The organization and training of older adults to improve the quality of living in small communities is being sought in a demonstration research project in Michigan.

For the past 5 years community programs in the fields of health, education, religion, home and family living, employment, and agriculture were undertaken to attack common community problems. These efforts resulted in improved education, hobby shows, public works, religious surveys, and many other useful community projects (Grim).

*Community Attitudes Towards Old Individuals*

Closely related to the problem of adjustment by people to conditions of later maturity is an evaluation of the attitudes towards older people, as individuals and as a group, as workers and as dependents, as recipients and as contributors. Movements to educate older people for constructive roles in society and, on the other hand, modifications of community enterprise to encourage participation of older people, can hardly proceed without scientifically established data on attitudes and prejudices.

As noted earlier, the negative attitude towards the elderly (Ginzberg) results in personality changes (Weinberg) and self-imposed restrictions on their activity (Kuhler). Additionally, the community—the family, the civic organization, the employer—impose conditions which make it difficult for older people to find a proper niche. In a survey of young college adults, numerous misconceptions concerning older people were registered and maintained. Particular reference was made to older people as workers. Despite the high educational level of the respondents, there was considerable acceptance of erroneous ideas concerning older workers' physical capacities, resistance to new situations, reaction to criticism, mental abilities, and interests in retirement. Women to a greater extent than men maintained these beliefs (Lorge). On the other hand, a pilot study in a typical upstate New York city, in which representative groups were interviewed, indicated that prejudice against older people, whether as workers or as individuals, is maintained to a greater extent by those who have stereotyped notions, whether old or young, men or women (Barron). Both authors stressed the importance of more information to prove or disprove such prejudices and conceptions.

*Work Practices*

These attitudes are reflected in positions taken by industry concerning older people and conversely the attitudes of older people towards work generally and the desire for retirement in preference to continuing at work.

From the point of view of the employer, several investigators noted the potentialities and problems of older workers (Pressey; Barrus; Breckinridge; and Franco). In a midwestern city, a survey of the value of older persons in a department store shows that older people may be increasingly used and may well prove more satisfactory than younger. Similarly, the older person was found to be satisfactory in a manufacturing company, and more than half of those age 60 or over were considered worth hiring. The older person represents a particularly valuable resource during emergency periods. With respect to accidents, it was found that they decreased frequently with age, and duration of disability increased only

slightly, so that the older worker is not a liability in this respect (Patch; Pressey, Stanton, and Smith).

Similar observations were reported from France. An auto manufacturer has found it feasible and practicable to utilize older workers, grouped together in a special section (un sénat) in which the work is paced in accordance with their physical and mental capacities (Huet). To meet problems of older people at work it was recommended that, in general, special arrangements be made in accordance with the requirements of the job. On the other hand, if it were deemed necessary as a matter of policy to retire older people in order to make places for younger men and women, pensions should be large and compulsory (Kutak).

Employment of older people in industry is linked with the problem of retirement. Today it is the rule rather than the exception for industry to develop formal retirement plans and many industries have developed preretirement counseling programs (Tuckman and Lorge; Breckinridge; and Ball).

A survey of over 100 of the largest corporations of the United States showed that all had some type of retirement program and that almost half are operating or are planning a preretirement course in addition (Tuckman and Lorge). Planning for retirement is the responsibility of the individual, the family, and the company for which he works, and preparation must be begun well in advance of the retirement date. Such retirement should be the joint venture of the personnel manager, the social worker, the physician, the individual, and his family (Cushing). According to the New York survey previously noted, older people believed generally that the decision concerning retirement should be primarily that of the worker (Barron).

*Attitudes Towards Work*

Several papers emphasize the psychologic meaning of work and retirement of older people and develop information that work has more than purely economic meaning to most American employees. It was noted that under ideal working conditions in this country many of the elements of leisure time activities are found in work undertaken for income. The reverse is also true (Havighurst; Friedman). On the other hand, among workers engaged in routine operations, heavy manual labor provides little opportunity for creative display. There is little interest in work for its intrinsic value. It is regarded solely as a means of earning a living and retirement at the earliest possible age, provided there is adequate security, which is earnestly sought. These conclusions were developed in a report on attitudes of coal miners and discussion of other occupations (Harlan).

*Sociologic Studies*

Attention was finally directed to particular groups of older people who were subjects of special study. A survey of retired people at St. Petersburg, Florida, indicated that a happy, healthful adjustment has been made by the majority of older people because of the wholesome climate and environment and the community acceptance of older people. Various clubs and groups have engaged in various civic enterprises which maintain their interest and alertness (Webber). In another study, two contrasting Florida communities were analyzed. St. Cloud has attracted people of moderate means like St. Petersburg, whereas Winter Park was deliberately established as a retirement home for the well-to-do. Despite essential differences in the level of economic and social opportunities it was considered that adjustments on the part of older people were relatively easier since they were able to develop their own programs and facilities, free of the usual antagonisms and prejudices met in other communities (Granick).

In quite another setting, the treatment of the aged was examined within the Anabaptist religious sect of the Hutterites located in the Western United States and Canada. These people have a reputation for good mental health and it has been found that many of the problems of older people in urban communities and even in rural areas in this country are not present among them. Responsible for this condition is the fact that small settlements in which the Hutterites are grouped maintain a continuing responsibility towards all members and the fact that the communal nature assures support to everyone (Eaton).

## Section 3.

### *Economics, Employment, and Welfare*

This section dealt with population trends as they affect the problem of aging and the complexion of the labor force; with the extent of, and the reasons for, the discrimination against the older worker, and efforts made to counteract this discrimination; with the problem of retirement, both as public policy and in terms of the individual's own adjustments; with the question of income maintenance for old people; with the problem of disability; and finally with the extent of welfare planning and community services now being carried on in behalf of older men and women. In all, a total of 42 papers were read or submitted.

*Population Trends and the Labor Force*

Changes in population characteristics underlie many of the problems associated with aging. The significance of the slow changes shaping the population of Western Europe and the United States has not been fully appreciated (Thompson).

Chronologic Aging—an increasing proportion of those 65 or over to the balance of the population—

is a characteristic of the West. It results largely from recent declines in mortality and even more recent declines in fertility. Most important are the significant improvements in infant mortality (Grauman). In industrialized countries, it is probable that in the near future 95 per cent of all children born will reach age 15, over 90 per cent will reach 45, and over 70 per cent will reach 65 (Kirk). These trends are likely to result in severe social problems which, however, may be modified by modern health, mental, and social attitudes (Grauman).

All this is altering the complexion of the labor force. In Western Europe, since 1940, the age group 45 to 64 is growing rapidly and the number of young adults, especially young men, has declined sharply. The efficient use of older workers presents one of the most important manpower problems facing Western Europe (Kirk). France, in 1950, had the highest percentage of persons 60 and over, 16.3 per cent, compared with 11.6 per cent for the U. S. A. Southeastern countries and the U. S. S. R. are uniformly below 10 per cent. The group of productive workers is decreasing relative to those who are dependent because of age—at both ends of the life scale (Daric).

In countries where there is still a large growth potential, as in Latin America, the problem of an increase in the number of older people is not yet serious. Social thinking is primarily directed towards lowering the still exorbitant rate of infant mortality (Chavero). The same holds true in general for Asian countries as, for instance, India where less than two-thirds of the children born attain the age of 15 and only about one-fifth survive to age 65 (Kirk).

In the U. S. A., since the turn of the century, there has been a fairly continuous decline in the proportion of older men on the labor force. Increases in the average length of the working life span of American men have failed to keep pace with the increase in biologic life expectancy. This trend has been regarded as an inevitable accompaniment of increasing industrialization and extension of mass-production techniques. The depression of the 1930's sharply limited employment outlets for older people. Older workers were encouraged to retire in order to "make jobs" for younger workers. This thinking was reversed during World War II when the older worker was recognized as an important part of the Nation's manpower reserves (Clague).

Public policy in the U. S. A. is today directed towards the more effective utilization of the older worker, not only for the defense emergency but for the long run program of maximum production. Improved health and higher educational standards will increasingly produce greater physical vigor and greater social and occupational adaptability among older workers. The developing importance of professional and service occupations may increase employment outlets in fields where the maturity, experience, and dependability of the older worker can be considered an asset (Clague).

*Employment of Older Persons*

Pragmatic definitions of employment vary with the tightness or looseness of the labor market. Each vested interest group—employers or unions—places its own welfare above that of other groups. There is a tragic dearth of information on all aspects of the employability of the older worker. Employers often have hiring limitations which discriminate against older workers in the belief that it costs more to employ them because of the likelihood of illness, absenteeism, susceptibility to accidents, physical "slowdown," etc. Most employers believe that pensions and compulsory retirement programs provide adequate solutions for the problems. Little thought is given to wider economic considerations. There are few programs to keep older workers at work. Labor unions are also negligent in this respect (Heneman).

A survey of 59 countries shows that discrimination tends to vary in intensity according to the status of the labor market, type of economy, cultural factors, and life span, rather than with the presence or absence of pension plans, workmen's compensation, or group insurance plans. Reference is made to the labor policies of Belgium, Iraq, and Italy in contrast to those of Holland, England, France, and (in part) the U. S. A., which try to mobilize the older worker. Research projects are needed: inter-disciplinary studies of attitudes of employers, foremen, communities, and oldsters; the role of older workers in an economy geared to low unit costs; the adaptability of industry to part-time work needs of oldsters; on-the-job adjustment problems, etc.; also, an educational campaign beamed at industry, unions, government agencies, and local communities as well as older and younger workers (Abrams).

Haphazard improvisation and selection of jobs can no longer be relied on. A systematic effort must be made to formulate principles and develop the experience necessary to revamp jobs to fit older workers, somewhat in the way jobs were adapted to include women and children in the early factory system and during World War II. This is primarily a responsibility of management. An analysis of present job distributions for older workers would be valuable, although it would suffer from the fact that the employer has already exercised selective controls. It would, however, be a start (Barkin). One approach to this problem, noted in a previous section of this report, is to be found in a French automobile factory which has grouped workers having at least twenty years of service in a special workshop, "le Sénat," where they are given jobs adapted to their physical capacities (Huet).

In the U. S. A. during a period of military conscrip-

tion and expanded production, the question of what to do for, and with, the aged worker may become industry's No. 1 concern (Franco). Present production plans in the U. S. A. call for a net increase in the labor force by the fourth quarter of 1952 of 3.2 million above that of the fourth quarter of 1950. Only 1.8 million of this number can come from "normal labor force growth." Most of the additional 1.4 million will have to come from older persons, especially women (Clague). To meet these continuing demands there is need for a vast reappraisal of present practices of retirement, employee training, and employees' health programs. Otherwise valuable workers will be lost to productive activity through retirement or disability. It is our responsibility, as a nation, to devise methods by which they can be used (Franco).

Reports from various countries show very little difference as to the age at which discrimination against the older worker begins. In the U. S. A., it seems to become generally noticeable at age 45 for men and 30 for women. Throughout the world generally, regardless of the life span in individual countries, discrimination against older men becomes general at ages 45 to 50 (Abrams).

The problem of the older person in industry consists of two parts: 1) getting a job; 2) keeping a job he already has. The first is the most difficult. Once out of a job, the older person tends to stay unemployed somewhat longer than does the younger, and he has a much harder time obtaining work (Abrams). In the U. S. A., the odds against the placement of industrial workers over 45 may run 6 to 1; in clerical and sales occupations, 4.5 to 1; and even in the skilled trades 2 to 1 (Odell). As employment increases, the aged tend to constitute a higher percentage of the unemployed—they are the last to be hired. In times of declining employment, they are first to be fired. Only where special skills of the older worker are considered sufficiently valuable by the employer does he have any special advantage over younger workers (Abrams).

*Efforts to Minimize Discrimination*

A number of agencies and organizations, both public and private, are now taking action to reduce or eliminate discrimination against older workers. This action, however, is as yet uncoordinated and relatively ineffective. In some countries, labor unions have tried to aid in breaking down age barriers to employment by heavy emphasis on seniority, use of hiring halls, control of hiring in closed shops, and opposition to compulsory retirement based solely on age. And some collective bargaining agreements have required the hiring of a definite proportion of older workers to total workers employed (Abrams).

Voluntary agencies in a number of countries have begun to undertake activities such as providing sheltered employment, giving specialized job counseling and placement, and undertaking research and educational programs. Universities and foundations are now beginning to do fundamental research on a sizeable scale. Many older persons have formed self-help organizations to cope with the problem. Activity on the part of various governments has taken such forms as educational campaigns, research on employability and aging, enactment of legislation to force or encourage employers to hire older workers, establishing training facilities open to the aged, and relaxing age limitations in the hiring of workers in public service (Abrams).

Studies made in this country and in England indicate that the jobs best filled by aged workers are the less difficult types of machine tending, clerical work, and unskilled work requiring no training. Highly skilled older workers can successfully handle jobs at their old trades if the time-stress is lessened. In all types of jobs, an important element in successful handling by old people is allowing them to work at their own speed (Barkin).

Special employment counseling for older job applicants can also contribute significantly to their success in finding employment. Two noteworthy experiments have been made in this field. The first, initiated in Toronto by the Canadian National Employment Service in 1947, showed that two-thirds of the applicants given special counseling secured employment almost immediately. One-half of these successful applicants were over age 60. Ninety per cent of all the successful applicants were still in the same jobs eighteen months later (Scott). Selective placement, such as has been developed by employment offices for handicapped workers and for veterans can be adapted to the aged (Klem; Covell).

The Bureau of Employment Security of the U. S. Department of Labor conducted a special study of older-worker placement in 1950, in collaboration with several State Employment Services. The experiment indicated that special counseling and services are effective not only in finding jobs for older workers (age 45 or over), but also in placing many of them in better jobs than they could have otherwise obtained (Goldberg). In Pennsylvania, for example, 60 per cent shifted from lower to higher occupational fields (as from unskilled to semi-skilled) and only 25 per cent to lower fields (Odell).

If older workers are to be integrated successfully into the working population, certain basic policies must be adopted and implemented forcefully by management, labor, and government: 1) elimination of maximum hiring age limits; 2) absorption of qualified older persons into employment before new people are drawn into the labor market; 3) equal consideration of older women along with men, on the basis of ability to do the job; 4) encouragement of able-bodied older persons eligible for retirement to remain at

work and for retired workers with special skills to return to their jobs; 5) elimination of arbitrary upper age limits in determinining eligibility for vocational rehabilitation (Odell; Goldberg).

*Note:* In respect to employment problems of the older worker, the reader may wish to refer to *Work Practices and Attitudes Towards Work*, in Section 2 of this report, (pages 278-279), and also to *Health Aspects of Employment and Retirement* in Section 4 (page 289).

*Post-War Trends in Retirement Plans*

Since the end of World War II, old-age security plans reflect changes in relative emphasis over the past fifty years, with no startling innovations. Pension plans fall into two general categories: 1) occupational or establishment plans where reward for long service is the dominant factor and pensions correspond to individual equity; 2) plans primarily designed to prevent destitution and where all other considerations are of secondary importance. The pattern emerging since the war shows the influence of monetary depreciation and concern with social adequacy and individual equity; also the fact of an aging population and policies of full employment. In Western Europe, the effect of inflation has been to minimize individual equity factors in pre-war national plans. Generally speaking, pre-war pensions have become worthless and the State is being forced, against actuarial traditions, to guarantee subsistence pensions against monetary depreciation. Few, however, have worked out the means of applying it. There is a tendency to raise pre-war retirement age by the offer of higher pensions for late retirement or by an abrogation of the means test. Except in Latin America, occupational pension schemes are no longer created by law on a compulsory basis; they become the private concern of industry without State subsidy or guarantee (Metall).

*Attitudes Towards Retirement in the U. S. A.*

Except among the well-to-do, the institution of retirement in the U. S. A. is a relatively new concept and one that the public as a whole has been slow to recognize and accept. In urban areas, at least, retirement is now almost generally regarded as an inevitable period in the individual's life span (McKain). Most workers, however, retire involuntarily because they have lost their jobs, for one of two reasons: either it is their employers' practice to separate workers at a specified age; or chronic illness or disability makes it impossible for them to hold a job (McConnell). However, a number of retirement plans established by collective bargaining now have a flexible retirement age or provision for review of retirements by the joint union-employer pension boards (Solenberger).

Rural workers are found to retire later in life than urban workers. The concept of retirement has not received wide-spread acceptance in rural areas and many people still cling tenaciously to the gospel of hard work. Also, the farm operator often finds it difficult to hand over the reins to younger workers because there is no one to take over, and to give up the farm entirely means too radical a change in his living conditions. It is easier simply to curtail operations by selling part of the livestock and land and enjoy partial retirement while retaining some means of livelihood. Voluntary retirement is difficult for the hired farm worker who usually earns less than the urban worker and has had little opportunity to benefit from pension plans. Up to recently, farm workers have not been covered by the old-age and survivors insurance and farm operators are still excluded. However, retirement is now being more generally accepted by the rural population (McKain).

All retirement, whether voluntary or compulsory, requires a major personal adjustment (Solenberger). Too little is known of the attitude of employees towards retirement or the details of the necessary adjustment. Definite information is needed as to how many can work and how many want to work. Many workers are obviously still capable of working and are willing to work, and retirement may be definitely undesirable or impracticable. Benefits under old-age and survivors insurance are comparatively small and most workers cannot accumulate sufficient supplementary savings during their working years to provide adequately for their old age. They are thus often confronted with a life of forced idleness aggravated by insufficient financial resources. Also, a very large part of our retired urban population is made up of aged workers whose illness or disability prevents their working. This is because of the high incidence and prevalence of illness among persons reaching the age of 65 or over. To their inadequate economic means is added the additional burden of hospital and medical expenses (McConnell).

Ideally, retirement should be a matter of choice for each individual worker. A more comprehensive system of social insurance is necessary to achieve this end, including expansion to include more categories of workers, making benefits more nearly adequate to meet living costs, and extending insurance protection to certain risks not now covered, particularly hospital costs. To this should be added a greater range of employment opportunities for those who wish to continue to work (McConnell).

*Income Maintenance for the Aged in the U. S. A.*

Employment is the most common as well as the best source of economic support in old age, but it is not a cure-all for the whole problem. In the U. S. A. only 45 per cent of all men over 65 are now gainfully employed and the peak reached in World War II was only 50 per cent. Less than 10 per

cent of the women in this age group have ever been employed. There are more older women than older men and only one-third have husbands to support them (Witte).

However, no matter how successfully employment opportunities for older persons are expanded the number in need of retirement income in the future will be very large. Regular employment is more or less out of the question for those beyond the age of, say 75, for the disabled, and for women who spent their younger years as homemakers (Ball).

Assistance from children and other relatives is declining. Individual savings is the principal reliance of less than 10 per cent of old people. So far, industrial and private pensions, while increasing, are paying benefits to only a few hundred thousands. Other public pension programs cover selected groups who are by no means the most needy. As programs of general application, therefore, both federal old-age and survivors insurance and public assistance are essential. Public programs, however, should attempt only to guarantee a minimum income sufficient for decent existence, with private means supplementing income beyond this minimum (Witte).

Nine out of 10 persons in the U. S. A. who work for a living are now earning retirement protection under one of the public programs. Nearly 8 out of 10 are under OASI, and the rest are under programs established for federal, state, or local government employees, for railroad workers, and for the armed services. In addition, there are perhaps some 12,000 private pension plans in operation under which around 10 million persons are working in jobs that will provide benefits supplementary to OASI provided they stay in that particular job long enough. This is a serious limitation of many private plans because of the great mobility of workers. Universal coverage under public programs has been very nearly obtained but the benefit situation is much less satisfactory. Although OASI is the only type of retirement plan for most people, it is paying the retired worker only an average of $42.00 a month. The average for those coming on the rolls when the new formula is fully effective will be only about $60.00 (Ball).

Retirement security for particular groups in our society cannot be assured on a sound long-run basis except through advancement of the retirement security of all groups. This requires a basic floor and security which can come about only through a substantially more comprehensive and effective public social insurance system than we have so far achieved (Solenberger).

The inadequacies of other sources of income have made federal-state old-age assistance essential for a large proportion of all persons 65 years of age or over. As of June, 1950, nearly 2,800,000 were recipients of old-age assistance. While roughly one-fourth of the people in the eligible age group receive such assistance, the proportion varies from 10 per cent in several states to more than 80 per cent in one state. The recent expansion in OASI coverage and increase in benefit payments is tending to reduce old-age assistance in the industrialized states to a supplementary program (as originally intended). The high assistance loads in the agricultural states, however, still present serious financing problems for these states (Winston).

A floor of protection such as is provided by the present level of social security benefits can probably be maintained without becoming too great a tax burden. However, complete and enforced support of the rapidly increasing older (nonproducing) groups may well become an intolerable burden on the younger, producing group. It is therefore up to each working generation to provide as much as possible for its own later support. Private insurance (annuities, retirement income contracts, etc.) offers a practical way of supplementing OASI benefits. While private pensions often tend to force retirement at an unnecessarily early age, insurance policies can be made flexible enough to defer income maturity value if the beneficiary is still actively working (Warren).

A rational approach to the whole problem of old-age security would consist of four components:

1. Planning for the employment of those who can and want to work;
2. Providing the major part of retirement income for most workers through a contributory social insurance system on a basis of universal coverage and adequate benefits;
3. Improving arrangements for supplementary protection to the extent necessary;
4. Providing special services for the aged in the form of housing projects, recreation projects, counseling, and other social services (Ball).

*The Factor of Disability*

Among older people, disability is the greatest cause of premature retirement. It is estimated that there are 25 million men, women, and children in the U. S. A. who are chronically ill, and that chronic invalids constitute 1.25 to 1.5 per cent of the population. Chronic illness should not be thought of as a problem of the aged alone; it strikes devastatingly among the middle-age groups. One million deaths and one billion days of disability a year are attributable to chronic illness. A survey in Sagamon County, Illinois, made in 1947 indicates that around 23 per cent of all public assistance recipients are chronic invalids and that over one-third of these require care from others (Hilliard).

OASI field surveys also show that two-thirds to three-fourths of the aged men and women currently receiving old-age insurance benefits are incapacitated. In a study of 20 cities over the period 1940-1947, from one-half to two-thirds gave ill health as the

reason for retirement. More recently, beneficiary couples were found to have spent an average of $160 a year for medical care; one-fourth spent as much as from $200 to $1,600. Most of these had to draw heavily on assets (one-half had little or no assets) or obtained assistance from relatives. Only 1 out of every 12 old-age family groups having a member hospitalized had any form of hospitalization insurance. Even fewer had any sort of medical care insurance. Because of this, many of the aged go without medical care or neglect chronic ailments (Falk and Hess).

Costs of chronic illness are both direct and indirect. Direct costs apply to medical and related expenses or to institutional care; indirect costs to loss of employment not only by the invalid but by those who must provide necessary care. Chronic illness forces more people onto public assistance rolls (at the expense of the tax-payer) than any other cause. Direct, and heavy, costs for the care of chronic invalids will more than double in the next thirty years unless research, treatment, and rehabilitation are intensified (Hilliard).

*Note:* Data on the medical aspects of rehabilitation may be found in Section 1 of this report and further data on disability in Section 4.

Along with the need of providing employment for able-bodied older workers is the need for returning to employment workers who have become disabled; also for protecting disabled workers against part of their income loss. This applies especially to those prematurely retired because of permanent and total disability. More people living to older ages means more people with disabilities and a greater total of economic losses. For the older worker disability becomes in effect premature retirement, burdened with extra costs connected with illness (Cohen).

The problem is twofold: it is necessary 1) to rehabilitate and secure employment for more of the disabled in order for the nation to maintain high levels of production and standards of living; 2) to provide income maintenance for those who cannot be rehabilitated and returned to productive employment, and for those who eventually do get jobs but must be financed over the often long period in which they cannot work (Cohen).

Loss of income because of disability is a vital factor in the problem. Although there are a number of programs, operated either by government or private industry, which provide various degrees of insurance protection, the majority of workers are still without any protection against permanent and total disability. In case of need, most of these have little alternative other than to turn to public assistance (Cohen).

The federal-state program of aid to the permanently and totally disabled, however, excludes many persons who are in need of, and who can benefit by, financial assistance. To become eligible for aid, under the program, a disabled individual must first exhaust his material resources. A social insurance program, as an integral part of old age and survivors insurance, would make benefits available to the individual before his funds were exhausted and would thus help to prevent his material and spiritual deterioration. It would facilitate the rehabilitation process by *guaranteeing* the security of the worker and his family during the process, and thus minimize the anxiety to the worker and his family. The level premium cost of disability programs suggested in the past has been estimated to range between 0.1 and 0.5 per cent of the covered payroll (Cohen).

### *The Health Needs of the Elderly*

The health needs of the elderly are numerous, complex, and varied, and in some respects quite different from those of other people. These health problems are characterized by long duration of physical and mental diseases and aggravation of illnesses arising earlier in life (Goldmann).

Many health problems, moreover, are not so much due to a deficiency in medical knowledge relating to them as to failures in accurate diagnosis and an early detection of symptoms. The diagnostic clinic is the heart and center of a forward-looking program of health services. Physical facilities in a health program for the elderly should also include general hospitals for those with long-term illnesses and small units within homes for the aged, or nursing homes. Services of all types of personnel from the general physician and specialist down to the nurses' aide and the home worker are also essential. The utilization of such auxiliary personnel as home-makers and housekeepers will greatly increase the comfort of, and service to, the homebound. Prescribed drugs, biologicals, etc., should also be included. Progress in scientific medicine, especially gerontology, and the education of the personnel are involved in such a program. Also important is the attention paid to "the full and discriminating use of health services and guidance of the disabled with the proper utilization of the functional capacity" (Goldmann).

Mental deterioration among the elderly often results from loneliness, desolation, and a feeling of being unwanted. Day Centers, where elderly persons can meet and participate in group recreation activities, have proved to be a very effective method of preventing such mental deterioration by providing a vehicle through which the elderly population can participate in societal activities (Hilliard).

In meeting the health needs of the elderly, two basic problems deserve consideration: proper organization of services and systematic organization for payments. Teamwork and differentiation of services must be oriented towards individual needs. Such differentiation and teamwork should also go far in reducing costs, mitigating shortages of the higher

skilled personnel, and freeing badly-needed general hospital beds. The cost of a comprehensive medical program should be met through insurance, general tax funds, or a combination of both, with emphasis on organized self-help (Goldmann). In meeting problems of this type the full resources of the community and experience of other agencies, such as workmen's compensation offices, should be employed (Read).

A proposal has been made to extend old-age and survivors insurance to include hospitalization benefits to insured workers and their dependents. This would help greatly to relieve some of the heaviest of the burdens of old age. The initial annual cost would be less than 0.2 per cent of the taxable payrolls and could be put into effect without altering the present schedule of OASI premium payments (Falk and Hess).

*Welfare Planning and Community Services*

Throughout the Western World, the increase in the percentage of the aged in the population has heightened government and private interest in the welfare of these older people. Governments have provided assistance and insurance systems to meet, at least in part, the financial need. Much more remains to be done, however, in such fields as housing, health, rehabilitation, and the meeting of social needs. The United Nations and its agencies are also interested not only in ascertaining what measures member states have taken with respect to the aged, but also in offering technical assistance in constructing an integrated program for the aged and the setting up of standards. A number of studies have been undertaken by the U. N. in these areas (Kahn).

In the U. S. A. a recent survey shows 164 communities organized to study social welfare needs of older people and to mobilize community resources to meet these needs. While recreation has been the first special effort, a consideration of employment needs has been the active concern of 38 communities, followed by health, housing, institutional care, and personnel counseling (Mathiasen). A small number of American communities now have well planned programs, facilities, and leadership promising continued growth, although very few have experimental programs. There is evidence that business and industrial leaders are becoming more concerned over the need for selective retirement policies (Swartz). A great need exists for well-planned, well-organized retirement programs in every business organization. Collateral groups in a community can be enlisted to give coverage. This should be one of the functions of adult education (Salamone). In general, however, there has been a substantial lag in many areas between the newer knowledge about the basic needs of old people and the application of these findings (Swartz).

In England, the National Old People's Welfare Committee includes all major voluntary societies, local government organizations, and advisers from central government departments. Its purpose is to help old people remain independent as long as possible. A network of local committees has been established which, through their constituent bodies, provides homes, clubs, meal services, visiting services, etc. (Ramsey). The Women's Volunteer Services, for instance, have established 18 Residential Clubs which permit residents to have their own possessions. Sickness and infirmity are cared for in their Half-Way Houses and Nursing Homes in cooperation with Regional Hospital Boards (Young). Chief emphasis in housing for older people is in adapting existing premises into bed-sitting rooms with cooking facilities. Originally financed by voluntary societies, the committees now receive some government help (Ramsey).

In Canada, community planning for older people has been developed in different ways in different communities. In Toronto, with 100,000 people over 60, the Division of Old Age in the Welfare Council has broad representation of lay and professional people from the public departments and privately financed services from Jewish, Catholic, and nonsectarian groups. Projects include a cooperative house where residents share work and expenses, a social center on city-owned property, counseling service by National Employment Service, traveling libraries, a holiday center, and a public housing project with apartments for old couples. There is also activity in Kimberly, B. C., Vancouver, B. C., and Saskatchewan (Good).

In Denmark, the nation subsidizes the cost of erecting and operating blocks of apartments for pensioners with rents as low as $5.00 a month for a couple and $4.00 for single persons. One-third of the municipalities also have special pensioners' asylums, where the aged have private rooms and their own furniture and furnishings and there is a ward for the sick. Medical care costs for pensioners are either borne by the municipality or taken care of by membership at low cost in a sickness fund. The aged are encouraged to continue work whenever possible through increased pensions for delayed filing. To expand housing facilities for the aged, subsidies are being increased and extended to nonprofit groups (Haarloev).

In Mexico, old-age pensioners are entitled to medical care and hospitalization for their families. Sometimes, these pensioners are provided with a hypothecary loan and a small farm in the country in order to maintain self-respect (Chavero).

In Venezuela, the government has established a modern institute for the aged and crippled with a wide range of services (Quintero).

Data on housing needs for the aged are unavailable in most countries. Fifty-seven of 68 countries report having old-age homes, serving from 1 to 8 per cent of the aged population. In many nations, how-

ever, the indigent are still dumped into "poor houses." The most promising trends are shown in the Australian cottage settlements adjacent to homes, the old-age homes in Sweden, the recent drastic changes in England's old-age homes, and the new services to resident and nonresident guests in U. S. A. homes. In general, noninstitutional housing is in two main categories: 1) those set aside for the aged in projects of flats and cottages for all age groups and 2) flats and cottages set up solely for the aged. The need for emphasizing self-sufficiency, privacy, and activity is underscored, as well as the danger of piece-meal planning (Abrams).

*Note:* Further discussion of housing will be found in Section 4.

## Section 4.

### *Medical Services, Hygiene, and Housing*

A total of approximately 80 papers were read in the sessions of the Section on Medical Services, Hygiene, and Housing. These papers and the discussions which followed dealt principally with the following topical areas: medico-social problems of the aging, health maintenance and the prevention of disability, medical care and services, institutional care, rehabilitation, housing and living arrangements, safety and accident prevention, and the health aspects of employment and retirement.

#### *Medico-Social Problems*

The aging group is increasing rapidly both in absolute numbers and in relation to the total population. The change in the age composition raises many fundamental problems. These include problems of health, housing, employment, recreation, education, and community life.

Chronologic age is not a satisfactory measurement of the true age of an individual. In each individual, real age is a composite of many factors (Bortz).

Older people have much to offer and should be accepted by the community. Moreover, the aging can contribute a great deal towards human dignity and wisdom, which must be reinstated as important social values (Gumpert). The basic needs of older people seem to be health, purposeful activity, companionship, security, and a sense of dignity (Bortz).

One of the main obstacles to progress is a heritage of the past—the idea that old age and disease are synonymous (Ginzberg). However, there is a large interrelation which should be considered; moreover, aging complicates chronic illness (Merrill). In addition, the reaction of the older person to illness provides many new medical and social problems. It is often impossible to separate the medical from the social problems, and both must be assessed and adequately met (Tunbridge). Boredom, inactivity, loneliness are factors leading first to social and then to physical breakdowns.

#### *Health Maintenance and Adjustment for the Older Years*

Preparation for healthy living in the later years should begin early in life. It was generally agreed that conditions which threaten the development of a chronic illness or disabilities which aggravate and hasten the aging process can be postponed or ameliorated. Thorough examinations might be given to individuals at significant periods in their lives to detect incipient disease and to anticipate and prevent further deterioration (Crampton). There should also be periodic health inventories at more frequent intervals as well as the use of mass screening examinations and other detection devices (Suttenfield). Older people, in general, do not participate to the same extent as do younger groups in obtaining periodic checkups and in responding to health campaigns. On the other hand, they accept drug advertising more readily. It is essential to develop media to which they will react and to recognize differences in their perception and needs in order to persuade them to take advantage of approved health aids (Kaplan).

Older people should be kept ambulatory as long as possible and usefully occupied (Thewlis). Useful activity is important in maintaining good mental health and integrity of personality (Vann). Proper nutrition would also help older people ward off many illnesses. Nutrition is a fruitful area for preventive and educational services. Many of the disorders and impairments of later life can be prevented or mitigated by greater attention to the dietary habits of older people and to their specific nutritional needs (McCay; Bortz). For instance, obesity, a dominant and troublesome characteristic of later life, can be treated successfully by reference to psychologic factors and recognition of modern treatment. A group of obese diabetic patients at a hospital clinic who had not responded to routine clinical treatment progressed significantly when subjected to group therapy which provided discussion opportunities for the class, stressing the emotional and related factors. (Schwartz and Goodman).

Physicians must begin to practice preventive medicine and to offer preclinical services (Thewlis; Suttenfield). The general practitioner must be kept informed in gerontology (Backer). Adequate health maintenance and care for the aging thus demands a reorientation in medical teaching among doctors and nurses (Tunbridge).

#### *Medical Care and Services*

*Health Status.* In a study of the present health status of older people and of future national trends, it was found that the annual case rate for chronic disabling illness among the general population was

approximately one-fourth the rate found among persons aged 65 and over. The average person in the older group suffered about five times as much chronic disability in a year as the average person in the general population. The degenerative diseases account for nearly one-third of the annual disability rates among the older group, but less than 10 per cent of the rate among the general population (Perrott).

An analysis of data gathered in two house-to-house surveys, conducted twenty years apart in Hagerstown, Maryland, showed that of persons 40 to 50 years of age in 1923, less than 50 per cent were alive and without chronic illness in 1943; and only slightly more than 20 per cent of those who were 50 to 60 years old in 1923 were alive and well in 1943. A substantial portion of the persons who are ill at 65 have had the same or another chronic illness for at least twenty years. Approximately 100 of every 1,000 persons who are well at age 45 will require, within five years, medical attention for the onset of a chronic disease or a major impairment. Nearly 25 per cent of those who are well at 60 will develop, within five years, a chronic ailment for which they will probably require medical care and, in many cases, care of a continuing nature (Ciocco).

It can be expected that the number of disabling illnesses will be about 20 per cent higher in 1960 and more than 40 per cent higher by 1975 (Perrott). It was also estimated that by 1980 there will be about 40 million persons with a chronic illness in the United States, a third of whom may need adequate hospital care for diagnosis, treatment, or rehabilitation. During the next fifteen to twenty years, some 300,000 beds will be needed for general categories of chronic illness, about 175,000 of these for active medical care and 125,000 for related care (Merrill). In the future we can expect to have relatively large numbers of people living to an age in which their health status will require expanded resources to meet the needs of services of physicians, nurses, and other health personnel, and for hospital care (Perrott).

*Use of Health Services.* According to the experiences of the Health Insurance Plan of Greater New York with its older enrollees (persons over 50), older people use very little more services of physicians than does the rest of the population. Older people had a larger proportion of their care given by general practitioners than did younger people, and required more surgery (Baehr). A study of health services under a system of compulsory health insurance in the Province of Saskatchewan, Canada, showed, on the other hand, that those over 65 received a much greater volume of care than those under 65. This was true for office and home care, as well as for hospital care (Mott).

*Principles of Care.* Geriatric services cannot be limited to the practical problems of clinical medicine alone. Effective treatment and restoration to activity demands consideration of nutrition, housing, recreation, employment, and all other aspects of the total care of the older individual (Freeman). A full nutritional analysis should be made of all older patients and kept as part of their permanent record (Bortz). Health workers and physicians also need to concentrate on the family rather than only on the individual in the study and treatment of illness (Friedman). Teamwork among all professional workers is needed for adequate and continuing care of the older person (Warren; Kinney; Zeman; Merrill).

*Organization of Services.* Since the need for medical services rises sharply at a time in life when income either remains fixed or diminishes, the aging benefit most from organized community health services (Mott). Any health plan for the aging must assure comprehensiveness, continuity, and integration of adequate medical and hospital care through the stages of health, acute illness, convalescence, and long-tern illness (Goldmann; Merrill). A comprehensive community program should provide for appropriate facilities which would enable patients to be transferred to those accommodations most suitable to their medical conditions (Merrill).

Geriatric facilities require the same high standards as other types of patient care facilities. A chronic disease or a geriatric unit should provide facilities for: 1) diagnosis and treatment of patients, both on an in-patient and an out-patient basis, 2) teaching, and 3) research (Warren).

Hospitals and related institutions can play progressive roles in public health programs by being the center for health and medical care activities concerned with chronic disease patients (Merrill). These hospitals should bring together into one functional unit the various components of comprehensive medical care so that they can be most effective (Rosenfeld). However, hospital beds must be used economically. Establishment of facilities and supplementary service to care for patients during convalescence and while at home can be of great help in relieving hospitals (Amulree). There should be specific planning for geriatric patients before they leave the hospital (Filson). The medical social service department is often the liaison between the community and the institution and can contribute by providing social service case work, knowledge of community resources, and administrative services (Baker).

A community health team consists of representatives of all health and welfare agencies, each of which has a place in solving the economic, physical, and cultural problems of the older person (Kinney). Integration of services can be under both governmental and voluntary auspices (Merrill). However, there is not just one pattern of community care for the geriatric and chronic disease patient. Each community should study individual needs and act accordingly (Merrill). There is also a large place for volun-

tary agencies in a system of medical services for older people. Voluntary agencies can offer such services as friendly visiting, "meals on wheels," provision of equipment such as linen for sick people, etc. (Warren).

*Clinics.* Geriatric clinics should not be separate facilities but should operate as specially assigned units within a general clinic plan. Such units should contain sections for the well aged, the acutely ill, and the permanently disabled. They could also serve as community centers for educational and recreational needs of older people as well as research centers (Freeman).

*Home Care.* Home care programs can fill a need for many persons who do not need active specialized care. Home care makes for a more effective use of hospital beds, at a reduced cost to the individual, his family, and the community as a whole (Thompson; Udell). One city has experimented with a home care plan which is coordinated and administered by a community public health nursing association. Under this plan, patients remain under the control of their own physician, and the hospitals in the area have no direct voice in the administration of the plan. The reaction of the hospitals, the private physicians, and the patients and their families to this plan has been very favorable. This arrangement might thus be a promising approach to home care of chronically ill older persons (Udell). Both the public health nurse and the hospital nurse have important functions on the inter-professional home care team (Kinney; Filson).

The American Red Cross has been sponsoring classes for home care of the sick. These classes have helped the families of older people care for those who are temporarily or permanently bedfast. The Red Cross is also prepared to assist hospitals in their home care programs by providing home nursing instruction (Grant).

*Financing.* Financing medical care for older people calls for group action (Rorem), or for the cooperative effort of individuals, voluntary organizations, and public agencies (Goldmann). Tax supported medical care for older persons should be explored, especially for those who are beneficiaries of tax funds for other necessities (Rorem). Voluntary and private insurance programs should be broadened and extended to cover long periods of sickness and disability (Merrill).

### *Rehabilitation*

Rehabilitation should be an integral part of geriatric services. With proper treatment, relatively few older people need be permanently bedfast (Cosin). Rehabilitation ends only when the disabled individual is capable of and actually returns to work at his highest attainable skill. Job placement and vocational rehabilitation agencies must make sure that no person is accepted for placement or training until a final surgical or medical end result has been obtained (Aitkin).

In one rehabilitation project launched in a typical county home in 1946, striking results were obtained for the older people who were treated. Without special or elaborate equipment, rehabilitation services brought notable improvement to all but 10 per cent of the fracture, hemiplegic, and amputee cases, most of whom were selected for the project because they were considered physically beyond hope or because they were so disabled as to be useless to society. Almost half recovered sufficiently to be returned to their homes and many in the 50 year and older group are now gainfully employed (Ferderber). A study of rehabilitation services in a geriatric unit in a hospital in England revealed that 38 per cent of the patients had been discharged within six months of admission and 14 per cent had been sufficiently rehabilitated to go to a "long-stay" annex (Cosin).

### *Institutional Care*

An institution for older people should be therapeutic and rehabilitative. The approach should be individualized and founded upon a knowledge of human behavior and motivations. Older people in institutions have a right to good medical care, comfort, protection, privacy, freedom of speech and action, good nutritious food, proper social and recreational life, clean shelter, respect for their possessions, and the right to worship as they please (Grossman). Homes should also be rehabilitation centers for constructive living and should provide opportunity for occupation and activity, preferably of a gainful nature (Weil; Warren). Older people are able to manage themselves and their lives better in a semi-protected environment when their sense of independence is respected and nurtured (Randall).

There is a great need for close cooperation between hospitals, nursing homes, and all other types of agencies and institutions dealing with the aged (Burney; Zeman; Frame). Standards in public and private nursing homes and other institutions need to be raised. Licensing laws and regulations are needed, but laws alone will not solve the problem; they must be one element in a broad, constructive community program (Pearson; Burney; Grossman; Frame). State and national associations have recently been organized by the operators of nursing homes to establish standards and raise the quality of care (Pearson). State health and welfare departments also have important responsibilities in this regard (Burney.) The licensing agency should know something of the qualifications, experience, and training of a prospective operator before the home is established. Also, preliminary training courses for operators should be the primary responsibility of the

agency charged with inspection, licensing, and maintenance of standards for nursing homes (Frame).

*Housing and Living Arrangements*

According to a recent survey, there was a total of 10,570,000 people over 65 who were heads of households living in urban or rural nonfarm housing in the United States in 1950. It is estimated that at least 80 per cent of all persons over 65 maintained independent households (Silk). In England, about 12.5 per cent of the pensionable population live alone and 85.5 per cent with relatives or friends (Tunbridge). In general, the aging in the United States tend to receive lower incomes, have smaller families, and occupy more older and dilapidated dwellings in older neighborhoods than do other groups in the population. However, overcrowding is not a particular problem for older people (Silk).

Housing can be a positive factor in promoting health and happiness of older people. However, the problem of housing and living arrangements for the aging will become more acute unless active steps are taken to solve it (Johnson). We need more research and study in the matter of housing for older people (Johnson; Loewenberg). There is a need for progressive and imaginative planning to provide independent congregate living quarters (Loewenberg). Only about a dozen countries have attempted special housing for the aging, with Sweden, Denmark, and England taking the lead in developing suitable housing projects (Abrams; Loewenberg).

Most older people want to live in their own households. In order to enable them to do so, even through mild illness, certain auxiliary aids should be made available. Among these are: visiting housekeepers to help with housework, home medical and nursing care, and the services of social case workers (Marquette).

Housing for older people should be planned around their psychologic and physiologic needs (Johnson). Self-sufficiency, privacy, and activity should be stressed (Abrams). Special attention should be given to such factors as light, heating, noise, provision for outdoor recreation, elimination of unnecessary stairs, and reduction of fire hazards (Johnson). On the other hand, there are dangers in piecemeal planning for special groups, in segregating housing facilities by the age of the tenants, and of making drastic shifts in place and type of living arrangements in the later years (Abrams). It is questionable, therefore, whether housing units need to be especially designed and reserved for older people (Marquette; Tunbridge). A more desirable approach might be to establish standards for features in housing that are desirable for older persons and for other small households. Then a concerted effort might be made to persuade private builders and local housing authorities to adhere to these principles in their planning and design and to induce both groups to provide more such housing for smaller families (Marquette).

*Safety*

Persons 65 or older accounted for 27 per cent of the 90,000 accidental deaths in the United States in 1950, with home accidents as the major hazard; 60 per cent of the accidental deaths among persons over 65 were due to home accidents. Well over half of these home accidents are due to falls and, among the aged, these falls occur more commonly on one level—not from stairs or high places. An experimental program of home safety education presented clear evidence that accidents can be prevented by mass educational methods (Fansler). However, educational activities alone cannot change the habits of a lifetime. There is greater need, therefore, to remove hazards and unsafe conditions. Family homes with aged members and institutions for the aged should take special accident prevention measures (Cole). Attention must also be given to motivation and psychologic factors, to personality traits, and to accident susceptibility (Meltzer).

*Health Aspects of Employment and Retirement*

There is an important interrelationship between employment, health, personal adjustment, and dependency. Public agencies should establish programs of research, placement, guidance, and retraining for older people (Breckinridge).

Age is a factor contributing significantly to sickness and disability rates; however, it is not a problem as far as industrial injuries are concerned (Crain). The continued employment of older and partially disabled workers is of utmost importance, particularly in view of current defense needs (Klumpp; Dodd). In order to prepare older persons for re-employment, or continuing employment beyond the retirement age, a comprehensive industrial evaluation survey is proposed to include thorough physical examination, detailed history, and knowledge of job requirements (Dodd). We also need to develop methods of determining physical fitness, functional reserve capacity, and selective placement (Klumpp; Hussey; Crain). By gathering information concerning physical requirements and job environment, some companies have been able to match the individual to the job. This system has disclosed a number of jobs not previously recognized as suitable for the older or impaired worker (Crain). Older workers must also make a greater effort to avoid the mental and physical atrophy of disuse (Klumpp).

Industrial nursing will tend to assume an increasingly important role because of its tenure in the field and because, in many industries, it is the only health discipline represented on a full-time basis. The

nurse can help the older worker develop proper diet habits, promote good posture and avoid fatigue, conserve sight and hearing, and maintain desirable psychologic attitudes (Devlin).

The fixed formula of retirement must be made more flexible and broken down into several alternative possibilities (Klumpp). There is no real basis for selecting 65 as the retirement age; analysis of work capacities is a better criterion (Hussey). The annual physical examination to determine individual health status enables the physician to develop valuable health records from which he can predict the abilities of individuals to perform work after 65 (Kammer).

Determination of biologic age is being explored through the assessment of five physiologic functions which usually change with age. No correlation has been found between any two of the functions studied. However, this investigation encourages the belief that through selection of adequate samples, standards of measuring capacity may be developed (Murray).

# Proceedings of the Research Session on Endocrinologic Aspects of Aging

Second International Gerontological Congress and Fourth Annual Scientific Meeting of the Gerontological Society, Inc.

Saturday, September 15, 1951

EDITED BY V. KORENCHEVSKY

THE meeting of the Session was held on Saturday, September 15, under the Chairmanship of Dr. V. Korenchevsky and Dr. J. A. Huet.

*1. Aims of the Session.* The Session was devoted to round table discussion for ascertaining those areas of endocrinologic gerontology which seemed to the Session as having been investigated insufficiently or not at all; also for consideration of the schemes and methods which might be used for investigation of these areas.

It must, however, be clearly understood that the conclusions arrived at and the research schemes defined at the Session represent only the opinions of the members of the Session and by no means can be considered as covering the subject completely. There might be different opinions and research schemes as important as those which were considered by the Session which other groups of research workers might suggest.

*2. Organization of the Session.* The one day allotted to the Session during the Second Congress proved definitely inadequate, especially when taking into consideration the aims, great importance, and responsibility of the work to be performed.

It is desirable that in the future these Sessions should work throughout the duration of the Congress, and, equally important, that their activity should continue in the intervals between the Congresses. If finances allow it, the meetings of the Sessions should be held at least once a year. In this way the advances in science and medicine can be taken into consideration and the conclusions and research schemes suggested could be adjusted to these advances.

In general, the structure and the forms of activity of these International Gerontologic Research Sessions will be somewhat similar to those of the International Committee which worked so successfully on the splitting of the atom.

The Governing Body of the International Association of Gerontology included the Research Session on Endocrinologic Aspects of Aging into its organization by the following resolution made at its meeting, September 14, 1951:

> "that the Research Session on Endocrinologic Aspects of Aging be continued in the International Association of Gerontology as long as is desirable."

At the Congress the other Sessions have not organized their activities in a similar manner. However, at the meeting of the Executive Committee of the Session held on October 21 at the Washington University School of Medicine, St. Louis, it was decided, on suggestion of Dr. W. O. Thompson, Dr. A. I. Lansing, and Dr. V. Korenchevsky to the President of the Association, Dr. E. V. Cowdry, to form a general "Research Committee on Biology and Medicine of the International Association of Gerontology" with the following sub-committees: cellular biology, endocrinology, pathology, nutrition and metabolism, and clinical pathologic physiology.

Dr. W. O. Thompson was elected the Chairman, Dr. A. I. Lansing and Dr. V. Korenchevsky the Secretaries of this Committee.

Thus, for future references, the Research Session on Endocrinologic Aspects of Aging was renamed "Endocrinologic Subcommittee" of the above mentioned Committee.

The whole organization of the Research Session was suggested and outlined in detail in the address of Dr. Korenchevsky at the opening Session of the Second International Gerontological Congress on September 9 (Brit. M. J., *i:* 375-376, 1952).

*3. Members of the Session on Endocrinologic Aspects of Aging.* The invitations for participation in the Session were sent to 43 scientific and medical research workers. The following 33 persons agreed to become members of the Session:

A. von Albertini. Zurich University, Switzerland
C. W. Asling, University of California, Berkeley, California
B. McD. Caldwell, Washington University, St. Louis, Missouri
R. R. Commons, Southern California University, Los Angeles, California
E. T. Engle, Columbia University, New York, New York
H. M. Evans, California University, Berkeley, California
J. Firket, Liège University, Liège, Belgium
K. J. Franklin, London University, London, England
W. U. Gardner, Yale University, New Haven, Connecticut
G. O. Gey, Johns Hopkins University Medical School, Baltimore, Maryland
M. A. Goldzieher, St. Clare Hospital, New York, New York
J. Groen, Wilhelmina Gasthuis, Amsterdam, Holland
E. H. Hashinger, University of Kansas, Kansas City, Kansas

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A. A. Hellbaum, University of Oklahoma, Oklahoma City, Oklahoma
F. I. Hisaw, Harvard University, Cambridge, Massachusetts
L. van der Horst, Amsterdam University, Amsterdam, Holland
J. A. Huet, Paris, France
J. E. Kirk, Washington University, St. Louis, Missouri
K. Knowlton, National Institute of Health, Bethesda, Maryland
V. Korenchevsky, Gerontological Research Unit, Oxford, England
W. B. Kountz, Washington University, St. Louis, Missouri
C. LaBelle, New York Medical College and Metropolitan Hospital, New York, New York
A. I. Lansing, Washington University, St. Louis, Missouri
R. A. Moore, Washington University, St. Louis, Missouri
P. Rondoni, Milan University, Italy
J. A. Saxton, Snodgras Laboratory of Pathology, St. Louis, Missouri
N. Shock, National Institutes of Health, Baltimore City Hospitals, Baltimore, Maryland
E. Simonson, University of Minnesota, Minneapolis, Minnesota
L. C. Strong, Yale University, New Haven, Connecticut
P. Starr, Southern California University, Los Angeles, California
A. P. Thomson, Birmingham University, Birmingham, England
W. O. Thompson, Chicago University, Chicago, Illinois
E. Witschi, State University, Iowa City, Iowa

Some of the above members of the Session presented research schemes while the others took part in discussions concerning these schemes or organization of the Session. For economy of space the discussions mostly were omitted since, in the following final drafts of the contributions, the authors took into consideration the critical remarks made or arrangements suggested.

*4. General resolutions proposed by Dr. Korenchevsky and approved by the Session.*

1. The resolutions made and all the research schemes suggested represent only private opinions of the members of the Session and under no condition exclude other important and necessary research schemes which might be suggested by other research workers.

2. It is obvious that investigation of processes of aging and of anti-aging effects should follow the usual lines of medico-biologic research, namely: (a) research on the living cells in tissue cultures, (b) on the living organism or parts of it, and (c) on the dead cells, tissues, organs, and organisms.

3. The great importance of both morphologic and bio-chemical research on isolated tissue cultures should be especially stressed.

4. In general the desirable schemes of research on the lines (b) and (c) can be suggested as follows:

*A.* Investigation of the effects of deficient secretion of each endocrine gland separately and also of the pluriglandular deficiencies on the processes of aging in animals and human beings, in particular the investigation of aging persons with endocrine deficiencies, occurring spontaneously or artifically induced for therapeutic purposes.

*B.* Investigation of the anti-aging and other effects of hormones on old animals and old persons who are suffering from a deficiency in the respective hormones. In particular, any possible harmful effects of hormones should be studied carefully on animals.

*C.* Similarly, and for control purposes, investigation of the effects of hormones on senescent animals and human beings with comparatively normal endocrine secretions. In this manner also the effects of artificial hypersecretion on the processes of aging can be studied.

*D.* To supplement *"C,"* by investigations of the effects of spontaneous endocrine hypersecretions on the processes of aging both in animals and human beings.

*E.* Investigation of tumor-producing-action of various hormones both on animals and in patients treated with hormones (in particular androgenic, adrenocortical, anterior hypophysis, and thyroid hormones) who die in circumstances suitable for pathologic-anatomic examination.

*F.* Investigation of the methods and tests suitable for the above mentioned research schemes *A-E.*

## DETAILED RESEARCH SCHEMES

The same or similar ideas, when they become "ripe" for research, occur simultaneously in the minds of several scientists. A good example of such a coincidence is observed in some of the following schemes.

These are arranged in alphabetic order of the names of the authors. They are also marked numerically. For easier orientation, at the end of the Proceedings an index is given according to the numerical order of the schemes.

### 1. *C. W. Asling, H. D. Moon, L. L. Bennett, and H. M. Evans:* **Relation of the Anterior Hypophysis to Problems of Aging.**

Of the 6 known anterior pituitary hormones, the functions of 5—thyrotropic, adrenocorticotropic, and the gonadotropic hormones (follicle-stimulating, interstitial-cell-stimulating, and lactogenic)—are intimately associated with the secretions of their target organs. Since the potentialities for investigation of relationships of the thyroid, adrenals, and gonads to problems of aging will be discussed by other essayists, this presentation will deal primarily with the sixth hormone—growth hormone (or "somatotrophin").

The growth hormone is unique among anterior pituitary hormones in that so little is known of the mechanism by which its effects are produced. Its characteristic action—the stimulation of increase in size by true increment of body tissue—is developed in the absence of any of the "target" organs. Its administration confers strangely youthful proportions on the nitrogen, fat, and water components of the body, even in old animals.

An expanded understanding of the "target mechanism" of this hormone offers promise of advance in our knowledge of how the body tissues undergo transition from youthful, through mature, to senescent characteristics. Of the many questions, three major (though closely interwoven) problems are offered as possessing urgent interest in gerontology. Their solution may confidently be expected to advance knowledge of basic biology and of the pathogenesis of certain medical disorders characterizing advancing years.

I. Why does growth stop? Studies are required on age changes in the pituitary content and blood level of growth hormone and in the responsiveness of the body to the hormone. This line of inquiry would also profit from investigations on species differences in responsiveness to the hormone, and even on study of a possible action of the hormone on tissue in cultures and on unicellular organisms.

II. What are the conditions under which growth hormone induces neoplasia? Although malignant neoplasms are developed during chronic administration of the hormone to normal adult animals, they do not appear in hypophysectomized animals similarly treated. The way in which the pituitary participates is unknown, nor do we know whether its removal would reduce tumor incidence in the more familiar experimental devices for inducing neoplasia.

III. How is growth hormone related to diabetes? Agreement is needed on the observed species differences in the diabetes-enhancing properties of the hormone. Amplification of metabolic studies to include fluid and electrolyte balance in these experiments is required, since growth hormone can be demonstrated to affect these components.

It is to be stressed that critical studies on growth hormone require the use of a potent preparation, pure by physico-chemical criteria and devoid of extraneous biologic effects when assayed at many multiples of the dosage employed.

*2. K. J. Franklin:* **Radiologic and Photographic Approach.**

Circumstances had prevented Dr. Franklin from preparing adequately for the Session, and all that—in the main—he could offer was a note on techniques that might be of use for recording objectively some of the results of aging and their amelioration by administration of endocrine substances. He began, however, by noting that in 1945 Sir Joseph Barcroft and M. Young had prolonged considerably the intrauterine life of animals by administration of prolan and that this might encourage endocrinologists about the possibilities at the other end of the life span.

He also mentioned that double-limb amputees of the first world war had not to date had anything but a few months' drop in expectation of life, although the older among them found their condition was beginning to be more of a strain. So the processes of aging are not necessarily seriously affected by loss of large parts of two limbs, which is a great tribute to the body's natural resilience.

With regard to recording techniques, he mentioned particularly the radiologic and photographic approach:

(A.) *Radiographic.* The late Dr. A. E. Barclay always stressed that the radiographic normal has still to be established for various parts of the body, e. g., the lungs. When x-rays were invented by Roentgen, the apparatus necessary for their production was available in most departments of physics, and they found so immediate an application to pathology that the physiology was never put on a proper footing.

(B.) *Cineradiographic.* Cineradiographic studies of those systems to which the technique, with or without the use of contrast media, is applicable would be of great service in establishing dynamic features of healthy and pathologic aging. Professor Robert Janker, of Bonn, has recently brought out a new direct cineradiographic technique, suitable for taking rapid serial, large-size radiographs of the human subject. Any functional movement is best recorded and reproduced as movement so as to retain and make measurable the dynamic approach.

(C.) *Cinematographic.* Slow motion studies of limb movements, etc. at various ages would similarly be of great service in establishing dynamic features of healthy and pathologic aging which are externally visible.

Both cineradiographic and cinematographic studies have the potential advantages inherent in moving picture techniques. Split-framing in particular is of great service in effectively contrasting the normal and the departure from it. Dr. Franklin also envisaged a not too distant time when stereo-cinematography of the movements of fluids in certain hollow tubes would become possible.

(D.) *Photographic.* It was scarcely necessary to stress the possibilities of the various kinds of photography in the objective study of aging, but obviously a properly organized effort would be of very great value.

Finally, Dr. Franklin referred to the large reserves of tissue present in many places, e.g., the sinu-atrial node is about seven times as large as is strictly necessary, the kidneys three times, even for the function (water retention), which is the first to be affected by reduction in total bulk, and so forth. Resistance to morbid process is to some extent bound up with the quantity of these available reserves and they should be more precisely defined and assessed.

*3. W. U. Gardner:* **Some Endocrinologic Aspects of Aging.**

We have or are investigating in our department the following aspects of aging.

Age changes in pituitary function and structure have been studied. Using physiologic and biologic tests it has been found that the activity of the pituitary decreases in advanced age both in castrated and in intact mice. This has been demonstrated by assay of pituitaries obtained from such animals and indirectly by studies of the pituitaries from young animals upon the ovaries of aged animals. Aged ovaries transplanted into young mice will become tumorous if these transplants are made in sites that are drained by the hepatic portal system and if the animals' own gonads are removed. Old ovaries very rarely become tumorous in old animals.

Age changes in bone have been studied in considerable detail and hormonal factors have been found to modify age changes. Several studies of this type have been published from our laboratory during the past ten years and are being continued. Young bones are now being grown in young adult, adult, and aged animals. It may be that such techniques will contribute somewhat to our knowledge.

Age changes in the rates of thyroid secretion in mice of different strains are also being studied. This is the technique first described by Herst and Turner.

The above are the major projects of direct interest for research to us now. Dr. C. W. Hooker, Professor of Anatomy, North Carolina School of Medicine, Chapel Hill, North Carolina, is also interested in age changes of the testis.

*4. T. Geill:* **Excretion of Hormones and Age.**

The diagnosis of disturbances in the function of the endocrine glands is generally difficult, but especially so in old people. The clinical symptoms are usually less distinct than in young people. It is therefore natural to look for such biochemical and biologic tests which are able to show the deficiencies of the endocrine glands.

It is of great importance to study the excretion of hormones and hormonal substances in the urine of normal persons all through life from the first years to senescence. Only in this way it will be possible to recognize the endocrinologic deficiencies in old people.

In Denmark the excretion of the sex hormones and of the 17-ketosteroids and corticoids has especially been studied by Hamburger, Pedersen-Bjergaard and Sprechler.

Hamburger showed, in 1948, that the excretion curve of 17-ketosteroids has a peak at 25 years. With advancing age the excretion decreases, first rather rapidly, later on more slowly. The mean excretion is larger in males than in females. The results of Hamburger have been confirmed by Robinson, Hamilton and Hamilton, Kirk, and Sprechler.

Sprechler recently investigated the excretion of the corticoids. He used his own method of determination (reduction method). The output rises from the first years of life to 20 to 30 years. The summit is not so pointed as found in the excretion curve of the 17-ketosteroids. With increasing age there is a smooth decline of the excretion curve until the 80th year. The excretion in males is a little larger than in females.

The scheme of future investigation is to study the excretion of 17-ketosteroids and corticoids in the urine in old people under various conditions.

The investigations will be carried out as team work (Old People's Town and The Serum Institute of the Danish State), and special attention will be given to the conditions under stress (ACTH and epinephrine).

The following groups of old patients are to be examined:

1. People who are aging rather suddenly.
2. Patients with the syndrome of Morgagni.
3. Patients showing symptoms of senile anorexia (loss of weight, glossitis, anemia, hypoproteinemia, osteoporosis).
4. Patients supposed to have adenomas in the adrenal cortex. Dr. W. Kiær, pathologist in Old People's Town, recently demonstrated the rather frequent occurrence of such adenomas in a large autopsy material.

*5. G. O. Gey:* **Cellular Gerontologic Research.**

The cellular physiologist must take a broad look at the problem of aging. By the use of our established continuous culture methods, it is possible to maintain a wide spectrum of cell types as uniform strains for years in a variety of media substrates. Such strains of cells allow us to evaluate their growth responses to a variety of agents which are physiologically active. As original source material one must of course depend upon the various cells within the tissue and oftentimes the responses of primary explants give a good indication of which cells are responding to the cultural conditions that are provided. Much basic information can be obtained from a comparative study of fresh tissue culture explants derived from young and old hosts and also through the use and maintenance of continuous cultures of strains of cells suspected of being affected by the aging process.

In the aging organism, however, marked hormonal deficiencies may exist, and it may be difficult to evaluate in the host the cell responses to hormonal or other treatment, whereas such treatment could perhaps be more easily evaluated in an isolated system where the cellular environment is under some control. Our concepts of cell "immortality" and what constitutes an aged cell have long been difficult to define when one is dealing with the cells of higher organisms such as those from animals and man. The discussions at this Congress on cellular aging brought us to no definite conclusion as to the state of affairs

at the cellular level in the aged host in higher forms such as man.

Within our own experiences, Mrs. Gey and I and our associates, as well as others, have observed quite remarkable stability of cell lines from mammalian hosts for periods of over twenty years with a few examples of cell lines which have shown variation, even to the production of neoplastic cells during the period of continuous cultivation. Under the conditions of continuous cultivation and proliferation, it would seem obvious that no cellular aging can occur. Cell lines established in vitro from young and old hosts under relatively uniform conditions have demonstrated their stability. Such cultured strains of mammalian cells, however, represent the products of definite stages of differentiation when derived from mature hosts. The simple continuous culture methods would seem to offer real opportunities to study further differentiation or a reversal or loss of some differentiated characteristics. A number of remarkable cellular variations have been observed, including the transformation of normal cells into malignant cells and even the loss of malignancy. Such celluar behavior could hardly be considered the result of the passage of time. It is more likely that specific injuries and other experiences not directly related to aging are responsible for the cellular transformations. Variation of hormonal background offers a real opportunity to influence cellular behavior and should be pursued with those cell systems that have been suspected of being affected by the aging process.

The experience of our group and of others justifies the emphasis on the need for further work in this field. Our position is well fortified by the knowledge that many types of human and animal cells can be maintained indefinitely in continuous cultures as apparently stable lines. Fortunately, the cells that can be grown indefinitely include cells of the endocrine system, thyroid, parathyroid, adrenal, etc. Many other differentiated cells may prove to be important objects of study. In fact the cells that can be cultivated indefinitely go back to and include the germinal epithelium of the ovary, and in such cultures follicles are formed. This knowledge that so many cell types of such a broad cell spectrum can be grown for indefinite periods is knowledge not shared by most biologists and clinicians. It therefore needs to be emphasized here.

In the aging host the cumulative effects of repeated injuries become manifest, especially when regenerative cell responses have failed to restore the necessary competent cellular reserves. Cell culture methods can evaluate the effect of continuous and discontinuous injuries on either dormant living cells or actively multiplying cells. The control of the cellular environment of cultured cells from the same specific tissue of young and old hosts provides a real opportunity to evaluate the physiologic aspects of aging at the cellular level. Under suitable circumstances, it is always possible to test the functional capacity of a cell by autologous re-implantation or following homologous transplantation. One could list a large number of fundamental inquiries which could be carried out with lines of young and old cells of similar histogenic origin. The newer cytologic procedures permit us to extend our inquiry directly to the level of cytoplasmic and nuclear constitution and of the ultimate organization of cells. The use of newer physical optics methods, such as phase and electronic microscopy and ultra-sectioning procedures coupled with a knowledge of the organization and behavior of living cells, should provide us with a real opportunity to evaluate the differences between old cells and young cells, if such exist.

The body fluids of young and old hosts permit us to evaluate the nutritional quality of such materials as cell substrates. Such inquiries, however, should be coupled with an extensive chemical characterization of the body fluids of young and old individuals. In this way we should be able to characterize more specifically the humoral aspects of aging and as evaluated directly on growing and living cells. The nutritional status, the effects of injuries, of infectious agents, the state of regenerative repair, and the creation of deficiency states, naturally or otherwise, alter the body fluids and extra-cellular environment for varying periods of time. Cell behavior and growth responses in fluids obtained from the altered normal host can be easily evaluated by present day methods. One needs only courage and scientific imagination to derive an answer to some of these perplexing problems.

*6. M. Goldzieher:* **Male Climacteric.**

It is a fact that all the symptoms characteristic of the female climacteric also occur in the male. Slight differences in the clinical picture are referable to variable prominence of one or the other characteristic symptoms which occurs more frequently in the female or the male respectively. Another significant similarity is presented by the observation that symptoms may occur in the female, sometimes before cessation of menstrual function, while in the male it is not uncommon that libido and potency are still maintained in spite of the characteristic clinical manifestations.

One would not hestitate to identify the clinical syndrome in the two sexes if practically identical clinical manifestations did not occur in some younger males who seek medical help for their sexual difficulties. These patients, as a rule, also present signs of psycho-neurotic disturbances. On a purely clinical basis, however, it is impossible to distinguish between the psychoneurotic who complains of impotence and the middle-aged or elderly male who presents climacteric symptoms with or without impotence. The only

way to separate these two groups is by a "controlled" therapeutic test: adequate dosage of testosterone propionate injected into such patients gives entirely satisfactory results in the one group and practically none in the other; if, unbeknown to the patient one exchanges the testosterone for a placebo the true climacteric patient shows recurrence of his symptoms and is relieved again when medication is reinstituted. No such reactions are noted in the psychoneurotic.

Laboratory procedures in general are of little help to confirm or disprove the diagnosis of the male climacteric. Our own data are somewhat at variance with older publications, but in perfect accord with the recent paper of Heller and Shipley, in the sense that an increase of urinary FSH excretion may or may not be present and cannot be used as a diagnostic criterion. Nor is there any statistically significant correlation between FSH excretion and urinary ketosteroids. The latter, however, have a certain diagnostic significance, for they are generally higher in the psychoneurotic even if identical age groups are compared.

It is important to emphasize that the climacteric in both sexes is primarily a metabolic disorder dependent upon a decrease in steroid hormone secretion. This decrease proceeds more rapidly and reaches its depths earlier in the female, whereas it develops only gradually in the male. It is likely to be accompanied by a decrease in libido and potency in the male but not nearly as consistently as menopause serves as evidence of cessation of ovarian activity. Our viewpoint that the climacteric in both sexes is primarily a metabolic disorder, while the sexual manifestations are merely secondary, is supported by the fact that the characteristic clinical symptoms sooner or later subside spontaneously in both sexes, yet without arresting the metabolic disorder which goes on and eventually leads to manifestations of senescence.

In contrast to the similarity of the clinical symptoms in the two sexes, the hormonal pattern shows definite differences: increased FSH excretion is encountered in 60 to 80 per cent of menopausal women and this high level is maintained in the post-menopausal state. In the male, according to different authors, the incidence of elevated FSH titers varies from 20 to 45 per cent. It seems to be higher in the presence of clinical symptoms. FSH excretion is more frequently elevated in the post-climacteric male.

The cause of these clinical and hormonal differences is not definitely established, but among the various factors involved the following seem to be important:

1. The decline of testosterone secretion takes place gradually and permits an adaptation to a lower hormone level.

2. The inevitability of the menopause as well as its symptoms are well known to all women and are expected by them when they reach a certain age. They watch for the symptoms and recognize them readily. The male is totally unprepared for, and uninformed about, climacteric symptoms. Moreover, his masculine vanity rejects the idea of the climacteric unless acceptance is enforced by total impotence. Even then he is not familiar with the symptoms and does not seek the physician's help.

3. Of considerable importance is the maintenance of estrogen levels in the middle-aged or aged male. This estrogen is presumably of testicular origin, for the presence of estrogen has been demonstrated recently in human testes material. Estrogen is far more effective in controlling FSH secretion of the pituitary than the male hormone, so much so that large amounts of testosterone, capable of producing symptomatic relief, are still inadequate to suppress FSH excretion. That testicular production of estrogen may be related to the relatively lesser frequency of high FSH titers of male urine is born out by the observation of Hamilton, who found that castration was followed by increased urinary FSH excretion in 100 per cent of the cases.

According to our views the male climacteric is the first symptomatic phase indicative of a significant decrease in testosterone secretion; the second phase of the frequently silent metabolic disorder is likely to remain permanent and tends to become progressive unless substitution therapy is introduced. Testosterone deficiency with or without clinical symptoms is present in the majority of elderly males as born out by the progressive decline of urinary 17-ketosteroid excretion in senescence.

If these views are correct, any treatment of male hormone deficiency must be of permanent substitution character. Its purpose is not restoration of sexual potency but correction of the existing metabolic abnormalities, especially in regard to protein and to general cellular anabolism.

It is rather unfortunate that testosterone medication does not produce the expected continued rise in anabolism as expressed by weight gain, nitrogen retention, etc. Hence therapy with testosterone alone disposes only of the symptoms of the climacteric but is inadequate to cope with the metabolic problems of the post-climacteric state. It is not fully understood why the effects of testosterone wear off upon prolonged administration, although clinical and experimental evidence points to depression of adrenal cortical function as one of the responsible factors. Addition of hormones to stimulate the adrenal cortex, such as estrogen, thyroid in small doses, and perhaps other steroid hormones, such as pregnenolone or progesterone, are likely to prevent the wearing off of testosterone effects. In our clinical experience, the administration of a potent cortical extract seemed to be most helpful in maintaining a continued response to testosterone therapy.

Further studies are urgently needed to ascertain which hormone or combination of hormones added to testosterone produces the optimal results. It might be interesting also to investigate whether beneficial effects can be obtained by the combination of testosterone and ACTH in suitable dosage.

In connection with Dr. Moore's discussion, I would like to bring up two questions which might be worthy of further study.

The human prostate quite frequently contains areas showing marked metaplasia, partly of the basal cell type and partly, although less often, of the squamous type. Is there any statistically significant correlation between these changes and the incidence of cancer of the prostate?

The second question relates to the estrogen excretion in male urine, which according to our own figures, as well as recent data of Pincus and his associates, is maintained in the elderly male at the level prevailing in young adults. Is estrogen excretion different in prostatic hypertrophy? Is there any correlation between estrogen levels and metaplastic changes of the prostate?

*7. J. Groen:* **Ketosteroid Excretion.**

The excretion of 17-ketosteroids decreases with aging. Modern methods of fractionation allow us to distinguish the ketosteroids produced by the adrenal cortex from those which are derived from the gonadal hormones. It is desirable to investigate the relationship of the changes of these fractions to the development of the processes of aging.

*8. E. H. Hashinger:* **The Determination of Thyroid Activity in the Aging.**

With our present day methods of (1) clinical estimation, and (2) laboratory methods, there is much that is wanting.

Of the laboratory methods (a) the BMR at best is a poor estimate of thyroid function, particularly in the aged who suffer concurrent ailments with cardio-respiratory deficiencies; (b) cholesterol, which we have noted consistently higher in the aged, may not necessarily be of thyroid origin, although being easily reduced by thyroid extract ingestion; (c) far too long iodine has been appraised as *the* factor in thyroid efficiency. This is not necessarily so, hence the determinations of PBI and iodine uptake are faulty factors for the estimation of thyroid activity.

Therefore, for the present, the keen estimation of the clinician must remain our best method for determining thyroid deficiency.

I think thyroid function definitely decreases with aging based on a long clinical experience. We need an accurate test for thyroid activity. Clinical response to thyroid medication cannot serve as a diagnostic certainty.

*9. A. A. Hellbaum:* **(A). The Influence of Certain Steroid Compounds in the General Metabolism of Aging.**

Attention has recently been focused on the influence of steroid compounds in certain metabolic processes of aging. These processes include the menopause, "adrenopause," collagen-fiber diseases, degenerative arthritis, atherosclerosis, cancer, hypertension, etc. Consequently it becomes increasingly important that more be known about the general fundamental metabolic activity of the steroid compounds. As a part of such a program, we are studying the relations between the morphologic and functional changes induced by certain steroid compounds in various tissues and organs, particularly the endocrine glands.

Selected steroids are administered in relatively large amounts over a long period of time to rats. Observations are made of the functional alterations correlated with morphologic changes. For example, cytologic studies are made of the pituitary glands and the findings correlated with the physiologic alterations in the gonadotrophic, thyrotropic, adrenocorticotropic, and somatotropic activity.

Similar studies are being conducted involving the thyroid, adrenals, and gonads in which the functional and anatomic relationships are noted and compared. In addition, alteration in reticuloendothelial system, bone, bone marrow, subcutaneous tissue, and skin are observed following steroid treatment.

Most of our difficulties in such a study are related to the lack of fundamental information. Dr. Franklin has just stated that radiology has concentrated on pathologic conditions. Perhaps many investigators pursuing endocrinologic studies, likewise, have paid considerably more attention to the abnormal than normal. Thus, we still do not know what the actual functions of various glands are. Certainly our concepts are changing. It is no longer accurate to refer to such well-known substances as androgens and estrogens as "male" and "female" hormones. The presence of both types of substances is not only demonstrable but essential for normal metabolic activity in both sexes.

Likewise it is possibly just as incorrect to refer to these compounds as "sex" hormones. When one considers their influence in such fundamental physiologic activities as protein and nitrogen metabolism, electrolyte and water balance, mineralization of bone, cardiovascular system and nervous function, we can no longer rightly refer to them simply as "sex" factors.

Another fundamental deficiency is the inadequacy of present tests used to measure the function of the different glands. We receive morphologic descriptions of certain changes from the cytologists and then attempt to evaluate these findings and correlate them with the physiologic alterations. But frankly,

I do not know how to test specifically for the function of various glands, including the pituitary tropin substances stimulating the thyroid, adrenals, gonads, etc. For example, we employ the customary determination of ascorbic acid as a measure of the function of adrenal and for the effect of ACTH (according to the methods of Sayers and Munson) but I am not certain that it is a true measure of adrenal function, for the role of ascorbic acid in adrenal activity is not clear to me. The same may be said of eosinophil or lymphocyte changes or the alterations in urinary "adrenal" steroids when used as a measure of adrenal function. Many changes may occur between formation in the adrenal and elimination in the urine.

The follicular stimulating factor (F.S.H.) is often measured by increase in uterine weight. Yet, we know that relatively pure F.S.H. has no effect on the uterus. Other substances are required with F.S.H. but the quantitative relationships for varying degrees of augmentation are unknown. The luteinizing factor (L.H.) is measured by changes in the ventral lobe of the prostate. We have considerable evidence which indicates that the factor inducing ovulation and subsequent luteal formation in the female may be entirely independent from that which stimulates the prostate in the male. Perhaps this test may serve to measure a "prostatropic" substance, but I question the advisability of designating it as a measure of the luteinizing substance.

Thus, as further plans for investigation involving the endocrines in the processes of aging are considered, it is desirable not to lose sight of the fact that we must still learn a great deal more about what the glands actually do and how their functions may be more accurately measured.

**B. Effect of Thyroid Administration in the Aging.** A tendency has been present in recent years to administer a number of different endocrine preparations to aging individuals in the hope that an elixir of life might be found. Because of the possible effect of thyroid on atherosclerosis, it has been variously stated that all individuals over a certain age should receive supplementary thyroid therapy. We propose to determine the effect of small doses of thyroid on a relatively large number of laboratory animals, controlled by an equal number not receiving thyroid. This will be conducted primarily on rats and hamsters. Animals will be chosen with known birth records. The thyroid administration would commence approximately half-way in their life span. Observations would be made of their general activity, health, and longevity. At the time of death, determinations would be made of blood cholesterol as well as thickness, weight, and content of the arch of the aorta, together with microscopic fluorescent studies of arteries to determine nature of the lipoid deposits. In addition, microscopic comparison of the thyroid of both groups will be made as well as the changes—in $I_{131}$ uptake and protein bound iodine.

*10. F. L. Hisaw:* **Physiology and Biochemistry of the Corpus Luteum and Placenta.**

The physiology and biochemistry of the corpus luteum of the ovary, decidual tissue, and placenta are suggested as subjects for the study of the phenomenon of aging.

*11. L. van der Horst:* **Castration and Processes of Aging.**

In Holland there is a considerable number of men who are castrated at their own request. They are criminals who are worried by their hypersexuality and who are confined in special institutions.

This group of castrates provides suitable material for investigation of the effects of castration on the processes of aging; namely, does the castration accelerate or retard aging? In other words, is there a relationship between sex hormones and growing old? In this investigation it is desirable to use all the clinical, biochemical, and psychologic methods suitable for the purpose, in particular the excretion of 17-ketosteroids.

*12. J. E. Kirk:* **In Vitro Studies of the Effect of Hormones on the Metabolism of Tissue Preparations from Old and Young Animals.**

I would like to suggest as a field for endocrinologic research in gerontology investigations on the effect of hormones on tissue metabolism, as measured by in vitro experiments, with emphasis on the responsiveness of tissues from old and young animals. Such studies should include investigations on both the aerobic and anaerobic metabolism and of as many of the intermediary steps in the chain of tissue metabolism as would be feasible.

The methods available for the study of the aerobic and anaerobic tissue metabolism are the well-known Warburg procedure in its many modifications and the method recently developed by myself and From Hansen (Federation Proc., *10:* 208, 1951), which was demonstrated at the exhibition of the Second International Gerontological Congress. The fields of application of the two methods cover each other to a large extent. The chief advantage of the Warburg procedure is its applicability to tissue slices, whereas the method of Kirk and From Hansen is particularly suitable for the study of tissue homogenates. The latter method further has the advantage of being three to six times more sensitive than the conventional Warburg method and is in my opinion superior with regard to the maintenance of sterility of the samples during the experiments.

I shall briefly mention some studies from the literature which illustrate the type of research which I have in mind. It should be pointed out that these studies, with exception of the publications by Belasco

(Endocrinology, *28:* 153, 1941) and by Belasco and Murlin (Endocrinology, *28:* 145, 1941), have not placed emphasis on the difference in response of tissues from old and young animals. The reported investigations have all been carried out with the Warburg technique.

Concerning the effect of thyroid hormone on tissue preparations in vitro, an investigation by Davis and Hastings (Am. J. Physiol., *114:* 618, 1935) on samples from the heart of Limulus showed that addition of thyroxine to the medium in the Warburg flask was followed by an increase in oxygen consumption of approximately 50 per cent, the rise setting in about fifteen hours after the addition. In later studies by Canzenelli, Guild, and Rapport (Endocrinology, *25:* 707, 1939) on pig and rat liver slices an increase in the oxygen consumption of the tissue was similarly observed after addition of thyroglobulin. Also in these experiments a considerable latent period was noted.

In vitro studies with thyrotropic hormone have been performed by Anderson and Alt (Am. J. Physiol., *119:* 67, 1937), using slices of dog and rat thyroid tissue. Ten guinea pig units of thyrotropic hormone were added to 15 to 50 mg. of thyroid tissue contained in a Warburg flask and the effect on the oxygen uptake of the slices recorded. The experiments showed an average maximum increase in the $Q_{o_2}$ values of 56 per cent. The increase was apparent during the first hour (17 to 53 per cent) and became more marked during the second and third hour. Similar in vitro studies with thyrotropic hormone have been reported by Galli-Mainini (Endocrinology, *29:* 674, 1941) and by Aleshin and Sarenko (Am. Rev. Soviet. Med., *4:* 269, 1946-1947).

Another approach to studies on the effect of hormones on tissue metabolism consists in the administration of hormones to animals over a suitable length of time, at the end of which the animals are killed and the tissues to be examined immediately removed for in vitro metabolism studies. By comparing the intensity of metabolism after hormone administration to young and old animals eventual differences in tissue responsiveness may be elicited.

Belasco (Endocrinology, *28:* 153, 1941) treated groups of rats between 2 and 12 months of age with subcutaneous injections of 0.2 mg. of thyroxine daily per 100 gm. of body weight for six days. The thyroxine administration resulted in a definite rise in the $Q_{o_2}$ value of the liver tissue, which in the two months' old animals increased from 7.5 to 9.1, the six months' old animals from 6.8 to 8.9, and in the twelve months' old group from 6.4 to 8.6; the corresponding values for kidney cortex were 17.4 to 19.8, 16.4 to 18.6, and 16.3 to 17.8.

The effect of thyrotropic hormone administration has been studied by several investigators. In a recent study by Borell (Acta med. Scandinav., Suppl. *161:* 1945) 2 guinea pig units of the hormone were injected daily into guinea pigs. After a single injection the $Q_{o_2}$ of the thyroid tissue showed an increase from 3.6 to 4.8. A greater increase in the oxygen consumption was noted after the injections had been continued for eight and twelve days, at which times the $Q_{o_2}$ values found were respectively 8.9 and 8.7. Studies with thyrotropic hormone similar to those of Borell have been carried out by Paal (Arch. f. exper. Path. u. Pharmakol., *173:* 513, 1933), by Canzanelli and Rapport (Endocrinology, *22:* 71, 1938), and by Belasco and Murlin (Endocrinology, *28:* 145, 1941).

*13. V. Korenchevsky:* **Research Schemes on Endocrinologic Aspects of Aging in Males.**

It is natural to expect that endocrine deficiencies should aggravate some processes of aging and that treatment with the hormones, which are deficient in old persons, should relieve, to a great extent in some cases, the affected processes of aging.

It is equally reasonable to expect that the treatment of old persons with normal endocrine secretions would result in the respective artificial hormonal hypersecretion, with some damaging effects. Thus, such treatment, besides being useless, may aggravate and accelerate some processes of aging.

The research scheme suggested are constructed on this hypothesis. It is supported by the results of Dr. Korenchevsky's experiments on rats and also by observations made by other investigators on young and old men, normal or suffering from endocrine deficiencies.

*I. Sex Hormones*

1. *More or Less Established Data, Basic for the Schemes:*

(a) Castration accelerates and aggravates some processes of aging in certain organs.

(b) As compared with animals and men with normal endocrine testicular secretion, the effects of sex hormones on non-sex organs are much more pronounced in castrated animals and men, or in those suffering from hypogonadism.

(c) Some of these hormonal effects appear to have anti-aging properties.

(d) Simultaneously with these apparently useful effects some harmful ones have been observed.

2. *Schemes for Experimental Research on Animals*

i) A detailed investigation on various suitable senescent and senile laboratory animals of the abovementioned points (a), (b), and (c). Besides morphologic, biochemical and functional methods and tests have to be used.

ii) Investigation of tumourogenic action of androgens alone, or in combination with other hormones, in *senescent* mice and rats.

3. *Schemes for Clinical Research in Research Hospitals*

A) To concentrate on androgenic treatment of those old persons who are suffering from a definite testicular endocrine deficiency as indicated, for example, according to some investigators, both by 1) increased excretion of gonadotropins in the urine and 2) decreased excretion of the ketosteroids.

B) To compare the effects obtained in A) with the effects of the same hormones and doses on old men who show a decreased excretion of ketosteroids, but not increased excretion of gonadotropins; and also on those elderly persons who have more or less normal ketosteroid and gonadotropin excretion.

C) To examine all organs of patients who were treated with sex hormones and who died under circumstances suitable for pathologic-anatomic examination with the purpose of ascertaining whether or not tumours had developed. Even those patients who had curative hormonal treatment in the cases of tumours (e.g., prostate or breast cancer) might be used for such an investigation. In such cases the best indication may be given by the rate of multiplication of metahyperplastic nodules in various organs (e.g., in the thyroid, adrenals, liver, pancreas, etc.) and their development into new tumours.

NOTE: For investigations of A) and B) it is desirable to use all available clinical tests and methods, in particular biochemical, functional, and psychologic.

*II. Thyroid — and III. Corticoadrenal Hormones*

Both for experimental and clinical research on the effects of these hormones, it is proposed to use schemes similar to those suggested for androgenic hormones, i.e., to investigate the effects of deficiency in these hormones on processes of aging and the anti-aging effects, if any, of these hormones on deficient old organisms as compared with normal individuals.

Of course, different tests and methods for ascertaining the deficiency in the corticoadrenal and thyroid hormones and also the assay of their anti-aging effects have to be worked out.

*IV. Simultaneous Deficiency of Old Persons in Two or More Hormones, and Plurihormonal Treatment of Such Persons*

The schemes of research have to combine all those above-mentioned procedures, methods, and tests as used in the cases of single deficiences.

*14. K. Knowlton:* **Metabolism in the Years of Declining Hormonal Functions.**

Although the studies made by Kountz and Ackermann, as well as others, have contributed greatly towards an experimental basis for knowledge of geriatric nutrition and the hormonal factors involved, much additional analysis is still needed of overall metabolism in the years of declining hormonal function. Greater significance could be attached to conclusions drawn from such studies, however, if they could be made part of an experimental set-up where different age groups of different and well-defined nutritional history were studied concurrently. These groups might preferably be composed of individuals chosen to represent various physical types and genetic constitutions. Some of the apparent disagreement over nutritional requirements of the aged might thus be resolved.

If real differences in nutritional needs during the aging process can be established, then a search should be made for qualitative or quantitative differences in metabolic pathways which can account for these variations. For example, if protein repletion on a given protein intake is slower in the person of 75 than in the young adult of 25 years, then a search should be made for differences in the course of conversion of absorbed amino acids through tissue protein to excreted urea. Such studies must of course be paced by advancing knowledge in the field of intermediary metabolism, but an active lookout should be kept for clues to these mechanisms.

*15. W. B. Kountz:* **The Influence of Hormones on the Nutrition of Older People.**

The relationship of hormones to nutrition is difficult to evaluate. We began by the study of the female and male sex hormones on older women. In order to do this we caused them to menstruate by the administration of estradiol benzoate, approximately 1 mg. two times a week as a basic medication, and progesterone or testosterone, which we found could be used interchangeably, 5 mg. daily for different lengths of time. The majority received this latter medication after bleeding had been induced, twenty days after the last menstrual period. All medication was given intramuscularly.

The questions to be evaluated consisted of (1) could the older individual's tissue be revitalized so that functionally and in anatomic appearance it would approach the state as noted in younger individuals? We were interested to know if the changes that occur with age are reversible or not. (2) We were also interested to know if disease developed in normal older people who received hormones and who had no evidence of malignancy before the studies, and (3) if the effect of these hormones was local on the genital tract or if they produced changes in other tissues.

The tissues of the body which were studied consisted of vaginal smears, uterus, nasal mucous membrane, breast, and skin biopsies. Before medication was given each individual was carefully investigated from a medical, psychologic, and gynecologic standpoint. In one group of studies which is reported elsewhere by Dr. B. McD. Caldwell, individuals were isolated in order to establish their psychologic rating.

Study of the vaginal epithelium revealed a marked increase in the number of cells and a tendency of some of them to stain heavily with the iodine, as

well as an increased stimulation during the period of study. Vaginal smears taken at regular intervals of three months have shown as much as 85 per cent stimulation during the studies.

Study of the endometrium was made during the course of observation by biopsy. Such a specimen was taken before the stimulation and at regular periods. The typical biopsy obtained from the resting, senile endometrium showed that the cells in the stroma were compact and seemed to be compressed together. Careful microscopic scrutiny revealed that they were relatively small in size compared to those of a premenopausal uterus. The glands were shown as relatively small areas compressed within the stroma. These cells were small and the nuclei were crowded at the base with a small central canal which was difficult to recognize in some sections. It is generally characteristic that no blood vessels are distinguishable in this type of tissue.

After stimulation of the tissue one found a decided change. These changes consisted of a m - tion of the stroma which was found to be less c- -ct and more edematous. The glands in the endometrium had much more cytoplasm at the base than they did before. The nuclei were found toward the lumen of the cells. The gland cells had increased in both length and diameter and the tissue resembled more that of premenopausal individuals. The lumina of the glands were large and with proper staining revealed a mucoid material. Many small blood vessels were noted in tissue taken at this time. These observations, we believe, establish the fact that the genital tissue of the body can be reactivated and caused to regain a more normal appearance as well as function.

When our studies were first begun we were anxious to know if the tissues could be stimulated without development of disease and we are able to say at this time after following a group for over six years that during our observations there has been no evidence of disease in any form, including cancer. After having made these preliminary observations, which indicated that there must be an increase in the blood supply to the uterus, we were exceedingly anxious to know what did happen to the blood vessels of the uterus which, in old women, are found to be very arteriosclerotic. Would these arteries be incapable of carrying adequate amounts of blood, and hence we would expect to find infarcts and scars in the uterine wall, or would these sclerotic arteries respond to the increased demand for blood? In order to make this observation it was necessary that we rely on postmortem examinations. Since we could not measure the change that occurred in any one individual it was necessary that we have controls of about the same age for the study. We chose older women who came to autopsy, therefore, of about the same age and with a similar gynecologic history, examined the uteri, and compared them with those of the individuals we were following to the postmortem table.

A comparison of blood vessels taken at autopsy from the uteri of the elderly individuals in the control group showed an advanced arteriosclerosis. Many of the large arteries were sclerotic and calcified and those in the muscle of the uterus wall showed marked hyalinization of the walls. Most of the lumen were very small and relatively little blood could have gone through them. In contrast, one could note in the blood vessels of the uteri of individuals who had received the injections that the lumen were relatively large in diameter even though some did have deposits of calcium in the media. Another point which we consider extremely important is the significant loss of the hyalin material in the vessel walls and the reappearance of normal muscle tissue in place of the dense hyalin always seen in the artery walls of the senile uterus. This is a definite change, and in many cases observed by Masters and ourselves over a period of several years a replacement of the hyalin material in the vessels by normal muscle cells is noted. In none of the uteri studied have we ever found evidence of infarction or scarring which would lead us to believe that the increase of function had caused a reduction in blood supply to any area. We have interpreted these observations as a lessening of the arteriosclerotic process, which suggests that one of the causes of arteriosclerosis may be a reduction of physiologic activity of the organ, and it could apply to other tissue in the body and, as well, to the entire organism. This lead, I believe, should be investigated.

In addition to the anatomic and functional aspects, the nitrogen balance of a group of men and women was studied. The use of androgen and estrogen established the fact that androgen had a definite protein sparing action and tended to increase the nitrogen utilization by the body in conditions of low protein as well as high protein intake. Estrogen had some protein sparing action on the nitrogen balance in individuals with a low protein intake but had no effect on individuals on a high protein intake. The use of other substances was also considered and thyroid was one of the substances studied. It was found to have relatively little influence on protein metabolism when given in moderate doses to the oldster except perhaps to increase the amount of food eaten. Insulin was likewise studied with reference to its influence on nitrogen balance. It was found that the substance had a moderate protein sparing action in some individuals. The influence of cortisone was studied and it was found that even with a high protein intake the individuals developed a negative nitrogen balance which lasted for a period of fifteen days, or longer, after which the body readjusted and compensated for the nitrogen loss. It was interesting that individuals on cortisone became much

more cheerful, much more interested in their environment, and their appetites improved.

It is suggested that more research be done on the influence of the hormones on the metabolism of older people since metabolism seems to be one of the important factors either directly or indirectly influencing the declining phase of the body.

*16. G. C. LaBelle:* **Endocrine Patterns and Clinical Pharmacology of the Aging.**

While every phase of the aging processes is under extensive scientific investigation, clinical pharmacology of the aging is still a relatively new field, especially in its relation to endocrine patterns. The New York Medical College and Metropolitan Hospital Research Unit by its clinical, biochemical, and physiologic facilities is combining its interest in the fundamental endocrine problems with a program of pharmacologic research of senescence.

SCOPE AND PURPOSE

I. *Basic Studies*

a. At a recent meeting of the American College of Physicians, Dr. Thomas H. McGavack, Director of the Unit, reviewed the fundamental aspects of the endocrine patterns during aging. This work is being intensified, using the most recent tools of research.

b. To determine the role of the endocrine factors in the production of fatigue and weakness in the aging.

c. To study the relationships of the endocrine patterns and the cardiovascular changes during senescence.

II. *Pharmacologic Studies*

a. The clinical screening of steroids, hormonal agents, and other therapeutic compounds which may stimulate, alter or reverse some of the endocrine patterns.

b. The search for therapeutic agents which will maintain, improve, or restore the well-being and the economic productivity of the aging.

c. The application of the objective methods of animal experimentation to clinical pharmacology in order to permit better correlation between the results of animal pharmacology and clinical research.

METHODS

I. *Clinical*

a. Collecting data through wide surveys on the clinical manifestations of aging.

b. Observations on the effect of various stresses on the onset and progression of the involutional phase of senescence.

c. Clinical observations on the onset of fatigue during aging, and its relations to preexisting disease.

II. *Physio-Chemical*

a. Biochemical and bioassay methods for blood levels, metabolism, and excretion of hormonal agents are constantly being tested and modified. We are at present particularly interested in extending and developing chromatographic methods for hormonal and pharmaceutic compounds.

b. External balance studies are being done on selected subjects.

c. The problem of measurement of osteoporosis in the aging is being investigated. H. Mack recently published a method of indirect measurement. We are working now on direct and quantitative measurement of osteoporosis through electronic methods.

III. *Physiologic*

a. Some objective methods of testing quantitatively the degree of fatigue in the aging and the response to therapeutic agents.

b. In addition to accepted methods of investigating the cardiovascular changes in the aged, the Fusion Frequency of Flicker and the Ballistocardiograph are being investigated as tools of research in relation to the role of endocrine agents.

*17. A. I. Lansing:* **Growth Hormone of the Pituitary.**

Throughout my studies on aging there has persisted a clear association between growth, growth regulation, and senescence. The evidence on the subject accumulates from work done by McCay, Child, Lansing, Ingle, and many others. Much of these data were reviewed elsewhere (Lansing, Physiol. Rev., *31: 274*, 1951).

It became most desirable, therefore, to explore the influence of the growth hormone of the pituitary on growth regulatory processes and aging. Through necessity such experiments must be long range and traced throughout whole life spans.

*18. R. A. Moore:* **The Prostate.**

The prostate gland is of interest to the gerontologist because there are two common diseases of this organ which cause great morbidity and mortality among older men—nodular hyperplasia (benign hypertrophy) and carcinoma. Neither of these two diseases is observed in people less than 40 years of age except for rare examples of carcinoma.

Nodular hyperplasia is the more common of the two and, on the basis of histologic study of the prostate of all persons over 40 years of age occurs in about 55 per cent; reaching a maximum of 75 per cent in those over 80.

Histologic studies of the prostate show that there is a demonstrable carcinoma in about 16 per cent of all persons over 40 with a maximum of 25 per cent in those over 80. Most of these carcinomas are small and cause no clinical symptoms; however, they are malignant.

Comparison of the incidence of each of these two diseases singly and together shows they occur independently of each other; hence they may have some

causal factors in common but the sum total of causation is different.

The human prostate gland consists of two essential parts: that which is represented only in the male—the posterior lobe with ducts emptying into the urethra distal to the verumontanum; and that which is represented in both sexes—the middle and lateral lobes with ducts emptying into the urethra beside and proximal to the verumontanum.

It is significant that most if not all carcinomas originate in the male prostate, that is, the posterior lobe, and that all instances of nodular hyperplasia originate in the ambisexual part, that is the lateral lobe.

It is also significant that degenerative changes in the cells of carcinoma of the prostate can be induced by injection of large doses of estrogen.

All of the facts on both diseases indicate they occur at a time when the androgen and estrogen levels of the body fluids are decreasing. The intimate relation to the testis is borne out by the extremely rare occurrence of both diseases in castrated men. In comparison with other phenomena in biology it seems possible that nodular hyperplasia is the result of irregular stimulation and involution during this period.

The more urgent problems for study in this field include more careful evaluation of the hormonal conditions under which the diseases originate. This cannot be done by simple measurement of the amount of hormone excreted in the urine but must be based on the amount of effective hormone in the body fluids in contact with prostatic tissue.

*19. P. Rondoni:* **Adrenocortical Hormones.**

1) A careful investigation of morphology of adrenal cortex in old age (when does the physiologic regeneration in interrenal tissue stop? Behavior of lipoids and pigments, etc.).

2) Adrenocortical hormones in old age: as different corticosteroids exert different influences on mineral metabolism, on fibroblasts proliferation (cortisone inhibiting), on inflammatory processes (desoxicorticosterone enhancing, cortisone depressing (Gross, Schweiz. med. Wchnshr., *80:* 697, 1950), on turnover of lymphatic tissues, it may be important to know whether some senile changes (fibrosis of organs, atrophy of lymphatic tissues, metabolic changes, etc.) are in some way related to changes of adrenocortical hormonal balance. How do old subjects respond to stress stimuli, which act through the adrenocortical secretion, or by means of other heretofore unknown mechanisms (Dougherty and Kumagai, Endocrinology, *48:* 691, 1951)?

3) Of especial interest is the investigation on the influence of hormones, chiefly of the adrenal cortex, on the type and course of inflammation. Such influence may change with aging. Such investigation may elicit different features of inflammation.

*20. J. A. Saxton, Jr.:* **Adenoma-like Hyperplasias of Endocrine Organs.**

It is desirable to bring up for discussion the possibility of a coordinated program by which the significance of adenoma-like hyperplasias islets could be determined. Such a program might bring about a clinical separation of various types of diabetes mellitus in people of advanced age with the possibility of directing treatment to the cause of the disease rather than mainly to correct the relative insulin deficiency.

There has been much work done along these lines as individual projects, and some studies have indicated a greater than expected chance incidence of adrenal hyperplasia in cases of diabetes. In our postmortem service between 5 and 15 per cent of elderly individuals have shown some degree of hyperplastic change in the adrenals, and in perhaps one out of 400 cases, small adenomas of islets cells have been noted in routine sections of the pancreas. It is possible that a more detailed study of the pancreas would reveal a high incidence of these lesions. Occasionally we have noted the co-existence of islet cell tumor and adrenal cortical hyperplasia with or without recognized endocrine disease.

A coordinated clinical and pathologic program would require a large number of elderly individuals with and without diabetes who would be willing to cooperate in clinical studies and who could be observed until the end of life. Such a group could only be found in an infirmary or sanitarium for old people. Detailed clinical and laboratory studies directed to the endocrine functions would be necessary as well as specific therapeutic procedures based on the findings. The clinical data could be correlated with detailed postmortem (histologic and bio-chemical) examinations in perhaps a large enough number of patients to be of significance.

*21. E. Simonson:* **Endocrinologic Aspects of Aging and the Muscular and Nervous Systems in Man.**

Direct experimentation on man has been made possible by the availability of various hormones but is based on the assumption of a faster rate of degenerative processes with age in endocrine glands than in other structures. In the general approach and experimental arrangements, investigations of hormonal effects are not too different from investigations of chronic drug effects and require the same experimental precautions. For a definite proof of hormonal effects on aging, the following experimental series and results would be necessary:

1) No effect in controls (placebos),
2) No, or comparatively small, effect in young normal people,

3) Substantial improvement in older normal people,
4) Substantial improvement in young people with hormonal deficiency,
5) Reversal of effect (in 3 and 4) when administration is discontinued.

This does not mean that the results in series 3 and 4 should be identical; on the contrary, quantitative as well as qualitative differences must be expected (Korenchevsky, J. Gerontol., *6:* 113, 1951).

Most important for demonstration of endocrine effects on muscle and nervous system is the sensitivity of the methods. Obviously, the changes are gradual and subtle and not accessible to the usual clinical methods, which fail often enough even in cases of definite disorders.

It is suggested, therefore, that various exercise tolerance tests be utilized on a larger scale than has been attempted in the past for the demonstration of endocrine aging factors on the muscle and nervous system as well as on circulatory and pulmonary functions involved in muscular work.

It has been our experience for a long time (Simonson and Enzer, Medicine, *21:* 345, 1942) that exercise tolerance tests are superior to investigation in resting condition. In a state of deficiency or, in general, of disease, the organism may be compensated in resting condition, but not for the superimposed stress of exercise. Investigation of the work performance is of importance not only for detection of age changes, but also for the prediction of the capability of older persons to earn their living. Certainly, reversal of some age trends (for instance the B.M.R.) by hormonal treatment would be of theoretical interest only if the treatment would fail to improve the working capacity at the same time.

Different types of work depend on different physiologic functions, so that a comparison of different types of work affords the possibility of a quantitative evaluation of the involvement of muscle, nervous, and circulatory system.

Table 1 shows a brief summary of work performance tests and physiologic functions involved. The list is not complete, but may suffice to show the great variety of muscle and nervous functions involved in various types of performance, and thus made accessible to precise, quantitative measurement.

The fusion frequency of flicker (f.f.f.) is that rate of successive light flashes where the sensation of flicker disappears and becomes the same as that of continuous light. The f.f.f. has been shown to be an index for the fatigue of the visual pathways and is probably representative of the fatigue of the central nervous system in general (Simonson and Enzer, J. Indus. Hyg. & Toxicol., *23:* 83, 1941, and Simonson, Clin. Proc., *2:* 112, 1943). Apparatus and measurement are simple, and numerous authors agree that the fusion point can be determined with great accuracy. Development of electronic equipment (Curtis and Simonson, Science, *113:* 547, 1951) contributes further to the ease of operation and the accuracy of the method.

In addition to the tests and methods listed in table 1, measurement of muscle elasticity by means of a ballistic elastometer (Simonson, Snowden, Keys, and Brozek, J. Appl. Physiol., *1:* 512, 1949) may be useful, since flabbiness of the skeletal muscle has been described as result of aging. With this instrument, the contact time between a small hammer striking the muscle and a metal plate placed on the muscle, as well as the rebound, are measured, and from these measurements an elasticity coefficient and viscosity coefficient can be calculated. The method is very sensitive to changes in muscle tension and has been successfully used in several types of muscle pathology.

It is suggested to combine several tests listed in table 1; such a combination is experimentally feasible and would give a good cross section of the effect of hormonal treatment on various muscle and nervous functions. Several tests, involving moderate or light muscular work or perception, can be taken on the same day within a total testing of one hour or so, followed by a type of severe work.

As an example of this approach, the results of methyl testosterone treatment are demonstrated in table 2.

Table 2 shows the effect of methyl testosterone treatment in 6 older men "A" (Simonson, Kearns, and Enzer, J. Clin. Endocrinol., *4:* 528, 1944), 4 young men with male sex hormone deficiency "B" (Simonson, Kearns, and Enzer, Endocrinology, *28:* 506, 1951), and 4 normal young men "C" (Samuels,

TABLE 1

| Type of Work Performance | Function, System Involved |
|---|---|
| Severe dynamic (Running bicycle ergometer) | Oxygen transport, pulmonary capacity; heart output; ability to accumulate oxygen debt, or lactic acid |
| Moderate dynamic (Walking; arm-ergometer) | Energetics (mechanical efficiency); circulation; motor-coordination |
| Recovery speed of oxygen debt | 1st part: circulation; 2nd part: metabolic (muscle, liver) |
| Static Work (weight holding) (endurance at 50% maximum load) | Resistance against peripheral sensations and peripheral ischemia |
| Speed; single movements | Muscle force (isotonic): Muscle viscosity; central nervous system |
| Repeated movements (tapping rate) | Chronaxie, refractory period of motor centers |
| Strength test (dynamometer) | Muscle force (isometric); central nervous system |
| Motor reaction time | Sensory—motor synapses |
| Flicker fusion frequency | Refractory period of visual (sensory) centers |
| Precision work | Motor coordination |

TABLE 2. EFFECT OF METHYL TESTOSTERONE ON CHARACTERISTICS RELATED TO WORK PERFORMANCE. MEAN CHANGES. TREATMENT WITH METHYL TESTOSTERONE FOR SIX TO FORTY WEEKS IN GROUP A, FOR FOUR WEEKS IN GROUP B, FOR ELEVEN WEEKS IN GROUP C. DATA FROM SIMONSON, KEARNS, AND ENZER [1] & [2] FOR GROUPS A AND B FROM SAMUELS, HENSCHEL, AND KEYS [3] FOR GROUP C.

| Group | A | B | C |
|---|---|---|---|
| Item | 6 Older Men, Normal but Easily Fatigued | 4 Eunuchoids and castrates, 21-47 Years Old | 4 Normal Men, 21-30 Years Old |
| Weight lifting | +72.8% | 68.5% | .. |
| Weight holding | 51.3% | 41.1% | .. |
| Muscle strength | 46.8% | 7.7% | 0 |
| Treadmill run | .... | .... | 0 |
| Flicker fusion, flashes per second | 6.4 | 3.8 | .. |

[1] Endocrinology, 28: 506, 1941.
[2] J. Clin. Endocrinol., 4: 528, 1944.
[3] J. Clin. Endocrinol., 2: 649, 1942.

Henschel, and Keys, J. Clin. Endocrinol., *2:* 649, 1942) on different types of work performance. The experimental arrangement was far from ideal both in respect to the number of tests and number of subjects. Nevertheless, the results are quite definite; 4 normal young men did not respond to hormonal treatment (column C), and the same was true for all groups with placebos (not included in table 2). The effect of methyl testosterone treatment was qualitatively the same in group A and B, but there were quantitative differences, such as might be expected from Korenchevsky's investigations (Korenchevsky, J. Gerontol., *6:* 113, 1951), although a different duration of the treatment period may also have played a role. The beneficial effect, however, disappeared within a few weeks when the treatment was discontinued. These results are encouraging so far as the demonstration of hormonal effects in aging is concerned, but discouraging as to testosterone treatment for combating aging.

The number of items listed in table 1 is by no means complete. A great number of additional tests is available, all of which might be of potential value. However, the chance of demonstrating positive effects of hormonal treatment will be greatest in those functions where definite age trends have been established.

In table 3 and 4 a list of such functions is presented. The list is not complete in regard to the number of items or quotation of literature, but even so, it exceeds the possibilities of any single experimental series.

Our suggestion to use work performance tests was made because the probability to detect early or relatively slight effects of hormone administration seems

TABLE 3. AGE TREND RELATED TO WORK PERFORMANCE AND FATIGUE-MOTOR PERFORMANCE.

| Item | Authority |
|---|---|
| Muscle strength | Quetelet[1], Rejs[2], Fisher and Birren[3] |
| Lactic acid accumulation, severe exercise | Robinson[4] |
| Oxygen debt accumulation, severe exercise | Robinson[4], Dill[5] |
| Maximum oxygen intake, severe exercise | Robinson[4] |
| Maximum pulmonary ventilation, severe exercise | Robinson[4] |
| Run at maximum speed to exhaustion | Simonson, Benton and Enzer[6] |
| Maximum work load (bicycle ergometer) | Norris, Yiengst and Shock[7] |
| Increase of pulmonary circulation, moderate exercise | Norris, Yiengst and Shock[7] |
| Recovery of pulse rate after exercise | Robinson[4] |
| Fine muscle coordination and speed | Miles[8] and Smith[9] |

[1] Sur l'Homme et le Development de Ses Facultés, L. Hauman et Cie., Brussels, 1836.
[2] Pflüger's Arch. f. d. ges. Physiol., *191*: 234, 1921.
[3] J. Appl. Psychol., *31*: 490, 1947.
[4] Arbeitsphysiol., *10*: 251, 1938-1939.
[5] Am. Heart J., *23*: 441, 1942.
[6] J. Lab. & Clin. Med., *28*: 1555, 1943.
[7] Federation Proc., *10*: 98, 1951.
[8] U.S.P.H. Rep., Suppl., *168*: 34, 1943.
[9] J. Appl. Psychol., *22*: 295, 1938.

TABLE 4. AGE TRENDS RELATED TO WORK PERFORMANCE AND FATIGUE-PERCEPTION AND INTELLECTIVE FUNCTIONS.

| Item | Authority |
|---|---|
| Fusion frequency of flicker | Simonson and Enzer[1]. Brozek and Keys[2] |
| Visual acuity | Chapanis[3] |
| Accommodation | Bernstein and Bernstein[4] |
| Discrimination of fine details in performance | Weston[5] |
| Visual threshold to light | Birren, Bick and Fox[6] |
| Color discrimination | Tiffin[7] |
| Stereopsis | Tiffin[7] |
| Auditory acuity | Bunch[8] |
| Capacity to form new comparisons, new associations, new ideas, to adopt new methods of working, to adjust to new situations | Fould and Raven[9] |
| Ingenuity problems | Sward[10] |

[1] J. Exper. Psychol., *29*: 517, 1941.
[2] J. Consult. Psychol., *9*: 87, 1945.
[3] Human Biol., *22*: 1, 1950.
[4] Arch. Ophth., *34*: 378, 1945.
[5] Brit. J. Ophth., *32*: 645, 1948.
[6] J. Gerontol., *3*: 267, 1948.
[7] Industrial Psychology, Prentice Hall, New York, 1947.
[8] Arch. Otolaryng., *9*: 625, 1929.
[9] J. Ment. Sc., *94*: 133, 1948.
[10] Am. J. Psychol., *58*: 443, 1945.

to be better than by investigation of physiologic functions in the resting state. There is no reason response to simulated high altitude, heat, or other stress situations should not be equally sensitive, although they would require a more elaborate setup.

This brings up the important question of environmental factors in their relationship to hormonal effect on aging. It is obvious that external and internal environment cannot be ignored in any long term research program on aging of muscle and nervous system.

*22. L. C. Strong:* **Genetic Investigation in Gerontology.**

Information on human families is available which demonstrates that longevity is inherited. There are short-lived families as well as long-lived ones. A similar biologic situation exists in mice of the various inbred strains. It is probably true that different organ systems age at different chronologic periods.

The grafting of normal tissues into $F_1$ individuals may provide means by which the aging process can be followed. For example, susceptibility to the growth of transplants of normal as well as neoplastic tissue is inherited as a dominant complex. The $F_1$ should then grow some of the normal tissues of both ancestral stocks. Thus a genetic means is available by which the biologic potentialities of two organs or tissues from animals which differ in the "aging process" can be compared in the same individual or in two individuals (the $F_1$ which are genetically identical).

Again suitable bio-assay methods of organs, particularly of endocrine origin, are known. It would be desirable, therefore, to compare the bio-assay of, for example, the pituitary from a long-lived strain during the entire life span with the data obtained with the pituitary of a short-lived strain. Would the bio-assay values be the same for a pituitary injected into a mouse of a short-lived strain as it would be in a mouse belonging to a long-lived strain? Does the aging process (loss of physiologic function) take place earlier in mice of the short-lived strain?

The genetic means are available which would permit the investigation on the aging process of the organ itself or its effects upon the rest of the organism. These methods are (1) the investigation of organs or tissues where a living and functional graft has been established and (2) the bio-assay of organs of different age periods where the data are obtained not by the continued functioning of the graft as in (1) but by the assay of a secretion of hormone or some other product that exists in a tissue at any particular chronologic age.

*23. Dr. W. O. Thompson:* **The Treatment of Toxic Goiter in Older People.**

The treatment of toxic goiter has been greatly modified by the introduction of anti-thyroid drugs and by the use of radioactive iodine. The preoperative preparation of patients with propylthiouracil has helped to reduce surgical mortality almost to the vanishing point because of the elimination of thyrotoxicosis before any operative procedure is carried out. It is pretty generally agreed that the best method of treatment of toxic goiter at the present time in most instances is a subtotal thyroidectomy after adequate preoperative preparation.

The reason that radioactive iodine is not generally used in the treatment of exophthalmic goiter at all ages is that sufficient time has not yet elapsed to be sure that it does not induce the development of carcinoma of the thyroid. The data available on the treatment of patients indicate that it does not. However, data must accumulate over a period of many more years before a final decision can be reached on this point.

In patients over 50 years of age there is little likelihood that carcinoma will develop during their expected life span as a result of the use of radioactive iodine and it is therefore much safer to use this material for medical management during this period of life than at an earlier age. Its use in older people should be limited largely to the treatment of patients with exophthalmic goiter and to the treatment of patients with nodular goiter who for some reason present poor operative risks.

The consensus among clinicians actively involved in the treatment of toxic goiter is that patients who have nodular goiters with hyperthyroidism should be subjected to a subtotal thyroidectomy after adequate preoperative preparation. There are two main reasons for this point of view:

1. Nodular goiters do not take up radioactive iodine nearly as readily as the exophthalmic goiter gland. Their resistance to the uptake of radioactive iodine means that the dose that must be employed is very much greater than in patients with exophthalmic goiter.

2. Carcinoma is more likely to develop in patients who have nodular goiters with hyperthyroidism than in patients who have exophthalmic goiter, although the incidence of carcinoma in patients with hyperthyroidism is low regardless of the type of goiter.

Radioactive iodine is also of value in the treatment of older people who have a recurrence or persistence of exophthalmic goiter.

It is important that careful observations be made of the end results of the treatment of toxic goiter in older people and that particular attention be paid to the question of whether or not the administration of radioactive iodine results in the development of carcinoma of the thyroid.

*24. A. P. Thomson:* **Adreno-Pause and Other Endocrine Disturbances in Old Age.**

I. The problem as to whether or not Albright's remark that there might be an "adreno-pause" in

the course of human life was justified.

II. From the point of view of a clinician, the most promising line of study would be the search for endocrinologic disturbance in those patients we meet in ordinary clinical practice who age very suddenly and drastically, apparently as a result either of sickness, bereavement, or some other form of stress.

*25. E. Witschi:* **Gonadotropins of the Human Hypophysis, Particularly in Old Age.**

The human hypophysis is outstanding by its high FSH content which in castrates averages 1 R.U. per 0.2 mg. dry powder of anterior lobe. This means that the content of an entire castrate hypophysis amounts to about 350 R.U. But the human is even more specifically characterized by its low LH fraction, which indeed is below that of other vertebrate hypophyses.

For the investigations on LH hormones a special test was developed in our laboratory (Witshi, Proc. Soc. Exper. Biol. & Med., *35:* 484, 1936) which we call the weaver finch test. African finches belonging to the genera *Euplectes* and *Steganura* have seasonal plumages with molts in spring and in the fall. In males certain feathers of the ventral pterylae are black in the nuptial plumage and white in the eclipse plumage. In the females the feathers of the same territories are white in both phases. Regenerating white feathers of these tracts, in either sex, react by the formation of black bars upon single injections of LH hormone. Melanin production is not, however, induced by human chorionic gonadotropin. This being a direct reaction of the melanophores of the feather germ to the LH hormone, it is obtained in castrates as well as in males and females, as outlined above. Also, admixtures of FSH, thyrotropic, adrenotropic, or growth hormones do not affect the reaction. The minimal dose which still records itself on the regenerating feather as a fine black bar constitutes the weaver finch unit (W.F.U.).

The mentioned peculiarities of the human hypophysis have to be taken into consideration if one wishes to make conclusions by analogy from animal experiments. Its uniqueness proves the importance of gaining all possible information directly from investigations on human materials. The assay of the total FSH content of human hypophyses is of particular interest because the three major phases of life, childhood, reproductive years, and old age are characterized by very different values.

Referring always to the total content per hypophysis, the different groups in round figures range as follows: children, 2 R.U.; non-pregnant mature women, 10 R. U.; mature men, 50 R. U.; postclimacteric women, 70-350 R.U.; men age 60 and above, 7-350 R.U. In women the castrate condition (350 R.U.) becomes established very abruptly at menopause and usually seems to persist throughout the last period of life. In men the picture is much more diversified. Of a "male climacteric" one might only speak in individual cases. Usually the castrate level of 350 R.U. is not reached before age 70 and then only by a relatively small group. In a majority of cases the hypophysis either maintains values near 50 R.U. or it loses in content, sometimes falling even to below childhood levels.

The results of the first of our determinations, extending also on the thyrotropic, lactogenic, and chromotropic agents, were published in two papers in 1940 (Witschi and Riley, Endocrinology, *26:* 565, 1940, and Witschi, Endocrinology, *27:* 437, 1940). Since that time considerable further material has been collected and a beginning was made with the parallel study of the histology and cytology of the human sex glands of various ages. If the proper support can be secured, it will be attempted to correlate the results so far obtained with the baffling situation of prostate development in men. Only extensive collection of data will disclose the nature of the relationship which must exist between the different forms of regressive and metaplastic developments in testes, the pathogenesis of the prostates, and the described variations of gonadotropic contents in the hypophyses.

Dr. Korenchevsky gratefully acknowledges that the President of the Second International Gerontological Congress, Dr. E. V. Cowdry, encouraged the new idea in every way and gave all the help possible in arranging the Research Session at the Congress. The cooperation of Dr. J. E. Kirk was very valuable both in the organization of the Session and at its scientific meeting.

## INDEX

The figures refer to the numerical order of the contributions.

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Anterior hypophysis and its hormones: 1, 2, 3, 4, 6, 9, 12, 13, 17, 22, 25.
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Cardio-vascular system: 9, 15, 16, 21.
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Tumour producing effects: 1, 3, 4, 5, 13, 15, 18, 20, 22.

# CURRENT COMMENT

**BOBST AWARDS IN GERONTOLOGY**

**Two awards of $250.00 each have been presented by the Bobst Pharmacal Co., Inc. to two of the most outstanding contributors to the Second International Gerontological Congress, which was held in St. Louis, September 9-14, 1951.**

**One of the awards has been given to Dr. Albert I. Lansing, Department of Anatomy, Washington University School of Medicine, St. Louis, for his presentation entitled "A Cytoplasmic Factor in Aging." The other recipient was Dr. J. A. Huet, Hôpital de Nanterre, Paris. The title of Dr. Huet's paper was "Organization et Rentabilité d'un 'Sénat' dans une Usine Française de Fabrication d'Automobiles."**

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**Newsletter**

At its September, 1951, meeting in Chicago, the Division of Maturity and Old Age of the American Psychological Association authorized the establishment of a *Newsletter*. The first issue of the publication appeared in February this year. Dr. Oscar J. Kaplan has been named Editor and Dr. James Birren will serve as Associate Editor. Contributions are solicited and should be sent to the Editor, San Diego State College, San Diego 15, California.

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**State of Minnesota Commission on Aging**

The State of Minnesota Commission on Aging will concentrate on four general areas of the problems of aging this year:

1) *Employment* — (Dr. Dale Yoder, Chairman): This category will concern itself with initial or continued employment at an older age, employment policies, training or retraining older adults to make the maximum use of their capacities, and rechanneling skills of the older adult to fit the needs of employment opportunities.

2) *Living Arrangments* — (Dr. John Anderson, Chairman): This section will concern itself with available living facilities for older adults. Licensing and health features will be included, as well as interfamilial relationships of which an older adult is a part. Physical rehabilitation is also an integral aspect of this section.

3) *Recreation and Counseling* — (Mrs. Nathan Berman, Chairman): This section will concentrate on outlets for use of leisure time, including social, craft, and service groups, education classes geared to the older adult, and adequate pre- and post-counseling to enable older adults to profit from these services. In addition, educating the public about the aging process is a further feature of this area.

4) *Economic Welfare* — (Mr. LeMont Crandall, Chairman): This section, as distinct from Section 1, will devote itself to the general area of OASI coverage — extent, adequacy, and coordination of private pension plans and the future role of OASI in the light of complete and adequate coverage through retirement planning.

Officers of the Commission are: Mr. Teman Thompson, State Representative, Lanesboro, Minnesota, Chairman of the Commission; Mr. Chester Graupman, McLeod County Welfare Board, Minnesota, Vice-Chairman; Mr. Jerome Kaplan, Hennepin County Welfare Board, Minneapolis, Secretary.

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**Southern Conference on Gerontology**

The Second Annual Southern Conference on Gerontology was held January 28-29, 1952, at the University of Florida, Gainesville. This conference was made possible through the cooperation of the University of Florida Institute of Gerontology and the General Extension Division and the members of the Governor's Commitee on Retired Persons. The conference was concerned primarily with problems of housing, economic support for older people, the organization of activities for older people, and nutritional and dietary problems of the aged. The conference was opened by Dr. John S. Allen, Vice-President of the University of Florida, and the final summary of the conference was presented by Mr. Nelson Poynter, Editor of the St. Petersburg Times. Following the presentation of more formal reports by experts from various fields, panel discussions were held in which members of the conference participated.

The establishment of the JOURNAL OF GERONTOLOGY was made possible by a grant from the Josiah Macy, Jr. Foundation.

The hieroglyphics, "The Beginning of the Book for Transforming an Old Man into a Youth," at the top of this editorial page, are from the Edwin Smith Surgical Papyrus, translated by Professor John Breasted, University of Chicago Press.

### Housing the Aging

Housing the Aging is the topic for the University of Michigan Fifth Annual Conference on Aging to be held in Ann Arbor, Michigan, July 24-26, 1952.

The conference will consider the housing needs of healthy, chronically ill, confused, and infirm older people living in urban and rural areas. Among the topics to be discussed are types of housing and living arrangements; architectural designs and costs; hygiene and safety standards; social and economic aspects of housing; and auxiliary services. The conference is designed to serve as a forum for interchanging information and for getting action on the difficult problem of financing housing for the aging.

The conference is directed to national, state, and local planners; physicians, nurses, and public health workers; industrial retirement counselors; welfare and social work personnel; architects, builders, realtors; safety and sanitary engineers; public and private investment and financing agencies; directors of old age homes, nursing homes, hospitals, and housing projects; and to older people themselves who are interested in contributing to the solution of the housing problem of the aging.

The conference is under the co-sponsorship of the Institute for Human Adjustment, Schools of Architecture, Business Administration, Social Work, Public Health, and the Medical School, Extension Service and Summer Session of the University of Michigan; the Michigan State Medical Society; the Committee on Aging and Geriatrics of the Federal Security Agency, Washington, D. C., and the Housing and Home Finance Agency, Washington, D. C.

Conference registration materials may be obtained by writing to Dr. Wilma Donahue, Institute For Human Adjustment, Room 1510, Rackham Bldg., Ann Arbor, Michigan.

### Minneapolis Directory of Senior Citizen Community Clubs

A directory of Senior Citizen Community Clubs in Minneapolis has been prepared by Jerome Kaplan of the Hennepin County Welfare Board, Minneapolis. A total of 29 clubs already in operation are listed. In addition, tentative plans for 6 senior age community camps to be operated in the summer of 1952 are outlined.

### Financial Support for Research on Aging

An illuminating analysis of the financial support given to research on aging has been published by Stella L. Deignan and Esther Miller in the March 28, 1952, issue of *Science*. This report is based on an analysis of 12,923 research grants registered with the Medical Sciences Information Exchange during the period 1946-1951. It includes research grants and contracts awarded by government and by the larger public and private foundations. Some of the pertinent data are summarized in Table 1. It is clear that gerontologic research has received only a small proportion of the total funds granted (0.83 per cent for the period 1946-1951) and that although the total funds available for medical research have increased markedly from 1946 to 1951, the proportion devoted to aging research has increased only slightly (from 0.57 per cent in 1946 to 0.86 per cent in 1951). In 1946, of the $4,307,441 available for medical research, only $24,493 were spent for research on aging. In 1951, out of a total of $32,893,609, only $283,075 was invested in research on aging.

TABLE 1. FINANCIAL SUPPORT OF RESEARCH ON AGING

| | Year | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1946–1951 | 1946 | 1947 | 1948 | 1949 | 1950 | 1951 |
| Total Grants | $135,044,125 | $4,307,441 | $10,254,340 | $21,457,747 | $33,130,118 | $33,000,870 | $32,893,609 |
| Percent Govt. Funds | 62 | 43 | 57 | 60 | 59 | 65 | 66 |
| Percent Private Funds | 38 | 57 | 43 | 40 | 41 | 35 | 34 |
| Funds for Aging Research | $1,125,297 | 24,493 | $54,458 | $211,581 | $240,050 | $311,640 | $283,075 |
| Percent Govt. Funds | 67 | 0 | 17 | 66 | 68 | 74 | 75 |
| Percent Private Funds | 33 | 100 | 83 | 34 | 32 | 26 | 25 |
| Percent of Total Funds Devoted to Research on: | | | | | | | |
| Aging | 0.83 | 0.57 | 0.53 | 0.99 | 0.72 | 0.94 | 0.86 |
| Cancer | 19.54 | 14.35 | 8.24 | 23.40 | 19.59 | 20.37 | 20.34 |
| Infectious Diseases | 17.68 | 22.18 | 28.58 | 18.03 | 16.15 | 15.65 | 17.06 |
| Cardiovascular System | 8.76 | 6.27 | 8.98 | 6.14 | 6.20 | 10.50 | 11.57 |

Data from: Deignan, S. L., and Miller, E. The support of research in medical and allied fields for the period 1946 through 1951. *Science, 115:* 321–343, March 28, 1952.

**Workshop on Community Resources for Older Adults**

Leaders in the field of adult education and gerontology will be interested to know that a workshop relating to these two fields will be held from July 28 to August 8 at the New York University Summer School, Chautauqua, New York. Co-directors for the workshop will be Professor John Carr Duff, Chairman of the Department of Adult Education, School of Education, New York University, and Dr. Wilma Donahue, Director of the Division of Gerontology, Human Adjustment Institute, University of Michigan.

The workshop is a follow-up on the gerontology workshop offered at Chautauqua last summer and both grew out of the National Conference on Aging held in Washington in August, 1950. Mr. Clark Tibbitts, Chairman of the National Conference on Aging and Chairman of the Committee on Aging and Geriatrics, Federal Security Agency, will be one of the consultants at Chautauqua. Dr. Karl Menninger, Dr. Harry Overstreet, and Mrs. Bonaro Overstreet are scheduled for lectures.

The workshop will be open to all persons interested in gerontology, whether they are matriculated as candidates for degrees or not; the tuition fee is $60.00, and the course carries three points of credit toward M.A., Ph.D., or Ed.D. degrees. Information about dormitory reservations, recreational facilities, and other matters of interest to those who register for the workshop may be had by writing to the Registrar, Chautauqua Institution, Chautauqua, New York.

**Only Housing Project of Its Kind in the U.S.A.**

In December, 1951, a $250,000 gift was presented to the Commonwealth Housing Foundation of Metropolitan Boston by the Home for Aged Colored Women, launching a unique experimental housing project for elderly people. The development will be located and designed in such a way that no segregation of the aging from the rest of the community will result. Tenants will be selected without regard to race or creed and will come from varying levels; one-third of the apartments will be available to those receiving old age assistance. Features include special recreation areas, a cafeteria, infirmary, and stores.

# ORGANIZATION SECTION

ERNEST W. BURGESS, *President*
University of Chicago
Chicago 37, Illinois

NATHAN W. SHOCK, *Secretary*
Baltimore City Hospitals
Baltimore 24, Maryland

JOHN ESBEN KIRK, *Treasurer*
5600 Arsenal Street
St. Louis 9, Missouri

EDMUND V. COWDRY, *President-Elect*
660 Kingshighway Blvd.
St. Louis 10, Missouri

## Financial Statements

GERONTOLOGICAL SOCIETY, INC.

Membership Account

For the year ended December 31, 1951

| | | | |
|---|---|---|---|
| Balance January 1, 1951 | | | $ 844.90 |
| Receipts: | | | |
| Memberships | $ 814.00 | | |
| Subscriptions | 3,167.00 | | |
| Total Receipts | | $ 3,981.00 | |
| Disbursements: | | | |
| Transferred to Journal Account | 3,167.00 | | |
| Third Scientific Meeting (St. Louis) | 36.97 | | |
| Printing and Stationery | 218.12 | | |
| Postage | 168.67 | | |
| Contribution to National Society for Medical Research | 100.00 | | |
| Fidelity Bond | 46.25 | | |
| Refunds | 10.00 | | |
| Miscellaneous | 2.58 | | |
| Total Disbursements | | 3,749.59 | |
| Excess of Receipts | | | 231.41 |
| Balance December 31, 1951 | | | 1,076.31 |

Note: Refunds in the amount of $452.50 are due members who registered at the Second International Gerontological Congress.

## GERONTOLOGICAL SOCIETY, INC.

### Journal Account

For the year ended December 31, 1951

| | | | |
|---|---|---|---|
| Balance January 1, 1951 | | | $12,313.46 |
| Receipts: | | | |
| Subscriptions | $ 8,279.04 | | |
| Advertising | 960.36 | | |
| Reprints | 1,324.95 | | |
| Engraving and Tabular Matter | 302.78 | | |
| Grant from Forest Park Foundation | 1,500.00 | | |
| Reimbursement from Second International Gerontological Congress | 1,656.00 | | |
| Revue Médicale de Liège | 22.50 | | |
| Total Receipts | | $14,045.63 | |
| Disbursements: | | | |
| Printing and Mailing Journal | 7,698.73 | | |
| Program for Second International Gerontological Congress | 6,322.46 | | |
| Salaries | 4,651.60 | | |
| Reprints | 1,670.14 | | |
| Publicity and Travel | 405.34 | | |
| Shipping and Postage | 349.19 | | |
| Office Equipment | 231.80 | | |
| Office Supplies | 114.69 | | |
| C. C. Thomas for 1946 Back Issues | 110.06 | | |
| Fidelity Bond | 46.25 | | |
| Accounting Service | 35.00 | | |
| Telephone and Telegrams | 20.43 | | |
| Refunds | 16.20 | | |
| Copyrights | 16.00 | | |
| Typewriter Rental | 12.32 | | |
| Miscellaneous | 42.14 | | |
| Revue Médicale de Liège | 21.38 | | |
| Total Disbursements | | 21,763.73 | |
| Excess of Disbursements | | | 7,718.10 |
| Balance December 31, 1951 | | | 4,595.36 |
| Recapitulation: | | | |
| Cash in Bank | | | 4,545.36 |
| Petty Cash on Hand | | | 50.00 |
| | | | $ 4,595.36 |

## 1951 ANNUAL REPORT OF THE MEMBERS OF THE GERONTOLOGICAL SOCIETY, INC., PURSUANT TO SECTION 46 OF THE MEMBERSHIP CORPORATIONS LAW OF NEW YORK

TO THE MEMBERS OF THE GERONTOLOGICAL SOCIETY, INC.:

The members of the corporation submit the following report for the year ended December 31, 1951.

| | | |
|---|---|---|
| (1) Real Property | $ 0.00 | $ 0.00 |
| Personal Property: | | |
| Cash deposit in the First National Bank: | | |
| Membership Account | 1,076.31 | |
| Cash deposit in Boatmen's National Bank: | | |
| Journal Account | 4,545.36 | |
| Petty cash fund | 50.00 | |
| Office furniture (St. Louis) | 250.00 | |
| Estimated value, back issues of the Journal of Gerontology, 1947, 1948, 1949, 1950, and 1951 (St. Louis) | 6,700.00 | |
| Total | | 12,621.67 |
| (2) Receipts: The amount and nature acquired during the year ended December 31 9,151: | | |
| Membership dues | 814.00 | |
| Subscriptions to the Journal of Gerontology | 8,279.04 | |
| Advertising, reprints, excess engraving and tabular matter in Journal of Gerontology | 2,588.09 | |
| Grant from Forest Park Foundation | 1,500.00 | |
| Total | | 13,181.13 |
| (3) Disbursements: The amount applied, appropriated or expended during the year ended December 31, 1951: | | |
| Printing and mailing Journal | 7,698.73 | |
| Program for Second International Gerontological Congress | 4,666.46 | |
| Salaries | 4,651.60 | |
| Reprints | 1,670.14 | |
| Publicity and Travel | 405.34 | |
| Shipping and Postage | 518.74 | |
| Office Equipment | 231.80 | |
| Printing and Stationery | 218.12 | |
| Office Supplies | 114.69 | |
| C. C. Thomas for 1946 back issues | 110.06 | |
| Contribution to National Society for Medical Research | 100.00 | |
| Fidelity Bond | 92.50 | |
| Accounting Service | 35.00 | |
| Refunds | 26.20 | |
| Third Annual Scientific Meeting | 36.97 | |
| Telephone and Telegrams | 20.43 | |
| Copyrights | 16.00 | |
| Miscellaneous | 44.72 | |
| Typewriter Rental | 12.32 | |
| Total | | 20,667.82 |
| (4) Summary: | | |
| Cash balance on hand January 1, 1951 | 13,158.36 | |
| Receipts during year ended December 31, 1951 | 13,181.13 | |
| Disbursements during such year | 20,667.82 | |
| Leaving a balance of | | $5,671.67 |

(5) The names and places of residence of the persons who have been admitted to membership in the corporation during the year ended December 31, 1951:

Dr. E. V. Cowdry
Wernse Laboratory for Cancer Research
Washington University School of Medicine
St. Louis 10, Missouri

Dr. A. I. Lansing
Department of Anatomy
Washington University School of Medicine
St. Louis 10, Missouri

Mr. Clark Tibbitts
Public Health Service, F.S.A.
Room 5700, Federal Security Building
Washington 25, D. C.

Dated January 8, 1952

State of Missouri } ss.
City of St. Louis }

Robert A. Moore and John Esben Kirk, being severally duly sworn, each for himself says: That the said Robert A. Moore was President, and that the said John Esben Kirk was Treasurer of the Gerontological Society, Inc. for the year 1951; that the foregoing is a report thereof showing the whole amount of personal property owned by said corporation, where located, and where and how invested; the amount and nature of the property acquired during the year ended December 31, 1951, being the year immediately preceding such date, and the purpose, objects, or persons to or for which such applications, appropriations, or expenditures have been made; the names of the persons admitted to membership in the corporation during the year; and that the corporation owns no real property; which report is in all respects true to the best of deponents' knowledge and belief.

ROBERT A. MOORE, *President*
JOHN ESBEN KIRK, *Treasurer*

GERONTOLOGICAL SOCIETY, INC.

Balance Sheet

*Assets*

| | | |
|---|---|---|
| Cash in Banks | $ 5,621.67 | |
| Petty Cash on Hand | 50.00 | |
| Total Assets | | $5,671.67 |

*Liabilities*

| | |
|---|---|
| None | -0- |

*Net Worth*

| | | |
|---|---|---|
| Balance January 1, 1951 | 13,158.36 | |
| Net Loss for Year | 7,486.69 | |
| Balance December 31, 1951 | | $5,671.67 |

# Gerontological Society, Inc. Committee Members for 1951

*Constitution and By-Laws Committee:*

Warren Andrew, Chairman
Department of Anatomy
George Washington University School of Medicine
Washington 5, D. C.

Wilma Donahue
Division of Gerontology
University of Michigan
Ann Arbor, Michigan

Robert J. Havighurst
Committee on Human Development
University of Chicago
Chicago 37, Illinois

Ephraim Shorr
Cornell University, Medical College
New York, New York

*Membership Committee:*
Nathan W. Shock, Chairman
Gerontology Section, U.S.P.H.S.
Baltimore City Hospitals
Baltimore 24, Maryland
George W. Ainlay, Sr.
1245 Glendon Avenue
Los Angeles 24, California
Nathan S. Davis
700 North Michigan Avenue
Chicago 11, Illinois
David Deren
1026 Park Avenue
Bridgeport 4, Connecticut
Joseph T. Freeman
1530 Locust Street
Philadelphia 2, Pennsylvania
John J. Griffin
Bureau of Old Age Assistance
City Hall
Sommerville 43, Massachusetts
James A. Hamilton
655 Sutter Street
San Francisco 2, California
James B. Hamilton
State University of New York
Brooklyn 2, New York
Roy G. Hoskins
86 Varick Road
Waban 68, Massachusetts
Harold E. Jones
University of California
Berkeley, California
Robert W. Kleemeier
Moosehaven, Orange Park, Florida
William B. Kountz
Infirmary Hospital
5600 Arsenal Street
St. Louis 9, Missouri
Robert T. Monroe
270 Commonwealth Avenue
Boston, Massachusetts
Elon H. Moore
University of Oregon
202 Oregon Hall
Eugene, Oregon
S. L. Pressey
Ohio State University
Columbus, Ohio
Ollie Randall
Community Service Society of New York
New York, New York
Henry L. Taylor
University of Minnesota
Gate 27, South Tower Stadium
Minneapolis, Minnesota
Jack Weinberg
Michael Reese Hospital
Chicago, Illinois
Frederic D. Zeman
111 East 88 Street
New York 28, New York

*Nominations Committee:*
Robert A. Moore, Chairman
Washington University School of Medicine
St. Louis, Missouri
Irving Lorge
Institute of Psychological Research
Teachers College, Columbia University
New York, New York
Clive M. McCay
School of Nutrition
Cornell University
Ithaca, New York

*Program Committee:*
Anton J. Carlson, Chairman
Department of Physiology
University of Chicago
Chicago 37, Illinois
James E. Birren
University of Chicago
5741 Drexel Ave.
Chicago 37, Illinois
Elizabeth L. Breckinridge
Illinois State Committee on Aging
160 North LaSalle
Chicago, Illinois
Joseph T. Freeman
Women's Medical College
Philadelphia, Pennsylvania
Otto Pollak
Department of Sociology
University of Pennsylvania
Philadelphia, Pennsylvania
Edward J. Stieglitz
7072 Hampden Lane
Bethesda 14, Maryland
Maurice Visscher
Department of Physiology
University of Minnesota
Minneapolis, Minnesota

*Local Arrangements Committee:*
Clark Tibbitts, Chairman
Committee on Aging
Federal Security Agency
Washington 25, D. C.
Warren Andrew
George Washington University School of Medicine
Washington, D. C.
Harold Jeghers
Georgetown School of Medicine
Washington, D. C.
Winfred Overholser
St. Elizabeth's Hospital
Washington 20, D. C.
Edward J. Stieglitz
7027 Hampden Lane
Bethesda 14, Maryland
C. J. Van Slyke
National Heart Institute
Bethesda 14, Maryland
W. Rulon Williamson
3400 Fairhill Avenue
Washington 20, D. C.

*Registry Committee:*
Wilhelm C. Hueper, Chairman
National Cancer Institute
National Institutes of Health
Bethesda 14, Maryland
Walter W. Jetter
Department of Legal Medicine
Harvard University
Boston 15, Massachusetts
Albert I. Lansing
Department of Anatomy
Washington University School of Medicine
St. Louis 10, Missouri

# BOOK REVIEWS

MAN AND HIS YEARS — AN ACCOUNT OF THE FIRST NATIONAL CONFERENCE ON AGING, sponsored by the Federal Security Agency, Health Publications Institute, Inc., Raleigh, North Carolina, 1951, 311 pages, $3.25.

The least controversial if not the most distinguished name to appear in this report of a public forum is Alfred, Lord Tennyson, by way of the ". . . Come, my friends, 'Tis not too late to seek a newer world" passage from *Ulysses*. In fact, by identification of name with written material, only Tennyson, Truman, Oscar Ewing, John L. Thurston, and Clark Tibbitts appear in the volume.

The method is a good one for reporting the content and conclusions of the first national conference on aging: it puts a focus on content and conclusions of the discussions and now and then draws a bead on a problem. The people responsible through advisory committee work and for each section are listed and some of their specific tasks are identified. The roster of planning committees, registrants, and section secretariats is a cross-section sample of valuable citizens and competent technicians interested in the aged. It is quite likely that the material will be valuable as a survey long after much of it has ceased to be definitive.

There is hope that the blueprint aspect of the conclusions will continue valid. For example, while recognizing the need for community (and governmental) responsibility, the report keeps a steady eye on individual initiative and his deep responsibility for himself and in his part in stimulating and developing resources for the entire community. In one way or another the theme runs through the deliberations: neither community nor government can solve the problem of aging; nor can the individual do the trick. Not even education, the resort of so many conferences, is availing; nor industry, religion, recreation. All of our social institutions and resources, plus the individual, have a task in meeting age.

In short, this conference strikes a balance of solid, meaty facts and judgment in a wide area of our common life: population changes and economic implications; income maintenance; employment, employability, and rehabilitation; health maintenance and rehabilitation; education; housing; aging research; religion — these and a few other subject areas were worked by fact-finding, mulled over in the forum, and here reported in a considered fashion.

The liveliness and freshness of the report is difficult to convey, but it should at least be said that no officialese appears in the pages. A complex and elaborate secretariat — a necessity in so large an undertaking — has seldom turned out more readable text. It is personal and direct.

The volume is a necessity for the planning of any activity for the aged and the aging. The arrangement of subjects and sub-topics is clear-cut and easy of reference, although the index is only fair.

On second thought, this reviewer has missed an implicit point in this report: the phrase "problems of aging (or of the aged)" is hardly recognized as a categorized matter. The forum does not shove the aged into a corner but keeps them as a part of the common life, with which life we all must deal. Above all, the aged are not dismissed with a hobby. A refreshing fact: "hobbies" is not to be found in the index.

The forum reflects great credit on the hardworking delegates, the advisory and planning committees, secretariats for each section, and on the central staff, the latter headed by Clark Tibbitts. In this extraordinary project the Federal Security Agency has done a good thing.

L. TOWLEY

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GROWING IN THE OLDER YEARS, edited by Wilma Donahue and Clark Tibbitts, with a foreword by Everett J. Soop, University of Michigan Press, Ann Arbor, 1951, 204 pages, $2.50.

This volume, devoted to health, hygiene and education in old age, is like its predecessors, *Living Through the Older Years* and *Planning the Older Years*, the result of a conference held at the University of Michigan under the auspices of the Institute for Human Adjustment and the University Extension Service. Taken together these volumes present an overall picture of the medical and social problems of old age. The papers here included were given during the summer of 1950 by a baker's dozen of well-known authorities. This volume properly takes its place with its two companions in any library devoted to old age.

In the space allotted it is impossible to do much more than list the names of the contributors and the titles of their papers, but before presenting this tabulation I wish to commend to the reader's attention particularly Dr. Weinberg's Psychiatric Techniques in the Treatment of Older People, Mr. Everett J. Soop's Proposed Programs in Education for an Aging Population, and Miss Ollie Randall's Training for Volunteers in Community Services with Older People, as incorporating largely new and hitherto unpublished material of great value.

The full table of contents is as follows:

National Aspects of an Aging Population
Clark Tibbitts
Mental Health in an Aging Population
Robert H. Felix
Changes in Emotional Needs with Aging
Moses M. Frohlich
Psychiatric Techniques in the Treatment of Older People
Jack Weinberg
Community Health Services for Old People
Joseph W. Mountin

Control of Degenerative Disease
William B. Kountz
The Industrial Physician and the Older Worker
Newton D. Leyda
Physical Restoration and the Older Person
Michael M. Dacso
Responsibility of Education to the Older Adult
Thomas A. Van Sant
Proposed Programs in Education for an Aging Population
Everett J. Soop
Training for Volunteers in Community Service with Old People
Ollie A. Randall
Group Development and the Education of Older People
Roger W. Heyns
A Mid-Century Forecast
Wilma Donahue

The foregoing makes clear the high quality of the contributors, and to the excellence of their presentations this reviewer bears willing testimony. Both inspiration and instruction await the experienced worker in the field who opens this book at any page, and for the beginner it offers the soundest of foundations.

F. D. ZEMAN

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THE PUBLIC HEALTH NURSE AND HER PATIENT, Ruth Gilbert, Revised Edition, 1951, A Commonwealth Fund Book, Harvard University Press, 1951, 348 pages, $3.75.

A sound criterion for evaluating a writer is the ability to improve through successive publications. "The Public Health Nurse and Her Patient" was highly praised when published in 1940 and the revised edition meets present expectations.

Miss Gilbert has a background of training and experience in Public Health Nursing and Social Work. She combines these experiences to give the public health nurse a better understanding of the dynamics of human behavior. The introductory chapter on Mental Hygiene in Public Health Nursing is followed by Teaching Health, Nurse and Maternity Patient, the Child in His Family, Nursing the Sick Patient, Relationships with Co-Workers. The six chapters have a related and developmental continuity but are a complete unit within each subject.

Selected case study material from everyday experiences of nursing records formulates concrete examples for the application of theoretical principles. Emphasis has been placed upon the recognition and use of symptoms in behavior as a basis for understanding the total problem. Behavior with irregularities should be studied from the standpoint of needs of the individual rather than as an isolated symptom. The public health nurse can contribute to growing and constructive experiences of the individual and try to guard against those known to be harmful at each level of experience. The test of good nursing procedures is how well they meet the needs of the patients on an individual basis. The approach to the place of the public health nurse as a member of the professional team is objective and suggestive of ways to improve her skills and obtain a higher level of productivity and satisfaction.

Miss Gilbert has quoted extensively from a wide range of authors on related subjects. The bibliography of 108 references provides an excellent resource for supplemental readings. The omissions of Anderson C. Aldrich from the bibliography and Cecelia G. Aldrich and Franz Alexander from the the index can be understood when one realizes the tremendous responsibility in editing such an exhaustive bibliography and index.

Although this book is written primarily for public health nurses it should have a direct appeal to the professional team and deserves a place in every professional library to be read and re-read where the nursing aim is to improve service to the patient, family, and community through the understanding of human behavior and the learning processes.

M. SANDERSON

---

PERSONNEL ADMINISTRATION IN PUBLIC HEALTH NURSING, William Brody, C. V. Mosby Co., St. Louis, 1951, 209 pages, $3.25.

Recently expanding programs of public health demand well trained qualified workers. To attract such individuals progressive personnel policies are a necessity. The author, who is actively engaged in formulating such practices for the New York City Department of Health, has attempted here to give other workers in the field the benefit of his own extensive experience. The book should therefore be of interest not only to public health nurses themselves but also to administrators of agencies concerned with public health.

The material is well organized and the style lucid throughout. Chapters are devoted to job analysis, recruiting, in-service training programs and employee practices, thus covering the nurse's career from indoctrination to retirement. Valuable appendices include a method of self-appraisal of the agency personnel program and typical short-answer examination questions. A brief serviceable bibliography is provided.

The insistance on high standards of administration and the practical nature of the author's recommendations make this book a valuable contribution to nursing policies and should be carefully studied by hospital administrators and heads of schools of nursing, as well as by those in the public health field.

B. D. GUBERSKY

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ADDING LIFE TO YEARS, by Lord Amulree, The National Council of Social Service, London, 1951, 101 pages, 14 illustrations.

In a concise form, Lord Amulree introduces the reader to the problems of the care for old people and the attempts to solve these problems in the

United Kingdom from old days up to the present time.

The following are the main parts of the book:— 1) Welfare measures, namely, visiting of the aged, the Clubs and home service for old people, arrangement of the proper meals, including "Meals on Wheels;" 2) Medical treatment of elderly and their rehabilitation, "home hospitals" as started by Dr. Bluestone in New York, the suitable treatment for the "frail ambulants" and "long-stay" patients, in particular the proper use of beds in hospitals; 3) Housing problems, as presented in the specially built houses or blocks of flats for old people and the modernisation of almshouses and "homes" for old people; 4) Employment of the elderly, as demonstrated by some statistical figures and illustrated by encouraging examples of the employment of old people in large factories.

Although the book is devoted chiefly to these problems and their solution in Great Britain, Lord Amulree briefly refers to the solution of some of these problems in Denmark, Sweden, France and the U.S.A. Of special value in Lord Amulree's book is his consideration of every problem on the basis of his own experience.

The size of the book indicates that it is not a "text book." It is, however, a good and clear presentation of the items discussed and the modern approaches for their solution. It can be recommended to social workers in the welfare organisations, local health service officers, and medical practitioners who want to become acquainted with the care and treatment of old persons in hospitals or in their private practice.

Among the deficiencies of the book might be mentioned a too short discussion on geriatric units in the hospitals and their aims. For example, nothing is said about an excellent possibility to perform geriatric research in these units.

The title of the book "Adding Life to Years" is perhaps too broad for the contents of the book: it is impossible to add true life to years without gerontologic and geriatric research.

However, some life has been definitely added to the old people who are at present housed and treated in modern ways, especially if one remembers their condition in not too distant times: in the past in the infirmaries, almshouses and homes for old people, as Lord Amulree so rightly states (p. 39) "an atmosphere of apathy in the wards was almost frightening; the patients lay almost like so many animals, with nothing to amuse or interest them."

V. KORENCHEVSKY

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THE CHANGING YEARS: WHAT TO DO ABOUT THE MENOPAUSE, Madeline Gray, Doubleday and Co., Inc., New York, 1951, 216 pages, $2.75.

The author, a Cornell graduate, took a master's degree in journalism at Columbia. After some years of professional literary activity she was personally confronted with a surgical menopause. And here she found to order a subject to challenge all her interest and skill. Four years were spent in analyzing the problem into its many facets and by wide reading and much thinking as well as interrogation of authorities to supplement her own experiences, finding much wisdom to address to the solutions.

Most of the literature that was studied would be dull going for the layman, but it is translated into chatty vernacular that entertains and edifies as it flows. The two major purposes of the author are to deflate the many fearsome superstitions that have accumulated about the menopause and to put at the easy disposal of the untrained reader a large proportion of the most sound knowledge now available regarding that trying experience.

In an introductory section an account is given of the female reproductive cycle and of the glandular happenings upon which it depends. The intricate story of the cycle itself is told with accuracy and skill but the endocrine background is filled in with an exhuberant vividness that departs here and there from strict technical exactitude — that occasionally confuses "may be" and "is." But the book was not written for endocrinologists and the women for whom it is intended will not be significantly misled from the relevant truth.

Among the many engaging features of the work are the discussions of the manifold symptoms of the menopause and the experiences of the author and her friends with the various hormones that can be utilized in their treatment. The need for intelligent collaboration with the physicians in charge is repeatedly stressed.

The book is at its best when it deals with the psychologic and social aspects of the menopause. Much sound counsel is offered on how to control circumstances, how to fill the emotional gaps when children leave home, how to remain alert and well poised, how to stay in love with one's husband and keep him reciprocating — in short, how to channel liberated energy into a fuller and happier life. Some of the chapter headings are: How your doctor can help you; How you can help yourself; What to do about your figure. The approach is frank and forthright; verbalistic pussyfooting is consistently avoided. The book is hortotory from beginning to end, but the sermons are so jovial and sprightly, so comprehending and astute, that no one can object.

The book is an important contribution to the problem of making the most of the later years. It should be widely read.

R. G. HOSKINS

PHYSICAL MEDICINE AND REHABILITATION FOR THE AGED, Walter S. McClellan, Charles C Thomas, Publisher, Springfield, Illinois, 1951, 81 pages, $2.00.

This monograph is very well planned but too briefly executed. One gets the impression that the author is too theoretical and has not modified some of his starting premises by the refinements of practical experience.

In dealing with geriatric patients one cannot escape the feeling that the major promise of rehabilitation lies in what the patient himself can be stimulated to do actively, and not primarily in administration of physical agents requiring mere passive cooperation. On the side of psychologic stimulation one needs to mention the importance of group therapy for the encouragement provided. The solitary aged person in the overprotection of the home or hospital room is a poor candidate. Dr. McClellan mentions limitations of what one can accomplish, but does not emphasize the above points.

The author's definitions and procedures are not particularly original. Procedures are not detailed enough and not specific enough for the elderly. Many of the techniques are outdated. References are skimpy and often quote sources too old to be useful. The illustrations are also disappointing. All but one are borrowed. Do publishers now insist on blacking out the entire face of photographic subjects? It certainly mars the effect of the illustration.

The reviewer is unable to recommend this book as a genuinely useful manual.

S. MEAD

---

SOCIAL CONTRIBUTION BY THE AGING, edited by Clark Tibbitts, The Annals of the American Academy of Political and Social Science, Vol. *279*, January, 1952, 179 pages, $2.00.

"This volume has a purpose. The purpose is to present an inventory of the characteristics of aging people, to assess their potentialities for further integration in community life, and to examine the conditions essential to maintaining such integration.

"The underlying philosophy of all the contributors is (a) that there are positive roles for aging and aged people through which they can make valuable contributions to American society and (b) that these roles offer opportunity for continuing, if not increased, individual satisfaction in the later years. A corollary of this point of view is that assignment of active roles to our older citizens will resolve many of the individual, family, and community problems that have arisen out of the growing number and proportion of older people."

These opening lines of the Introduction by Clark Tibbitts and Henry D. Sheldon summarize the intent of this very useful and readable little book. The content consists of 22 relatively short articles by as many different writers, all actively working in the young science of gerontology.

This book will be especially useful to students and to study groups who want a summary of the current facts about older people and the attitudes held by people who are working with and studying older people. The article by Wilbur J. Cohen on "Income Maintenance for the Aged," for example, collects in one place the recent data on sources of income, Social Security, and Old Age Assistance, with estimates through 1952.

There is an interesting debate on the question, "Should There Be A Fixed Retirement Age?" with the president of Esso Standard Oil Company saying Yes, the director of industrial relations at Eastman Kodak Company saying No, the director of research of Textile Workers Union of America saying No, and an agricultural economist arguing that farmers should not retire, but should retreat gradually from the heavier farm work and should live out their years on the land.

Especially useful to non-medical persons will be the article on "Physiological Changes in Aging" by Anton J. Carlson and Edward J. Stieglitz, which brings down to date an earlier article by Dr. Carlson bearing the same title.

There are four main sections, entitled:

Needs and Capacities of Aging People
Contribution to the Productive Economy
Contributions to the Cultural Life of the Community
Maintenance of Capacity for Social Contribution

R. J. HAVIGHURST

---

THE BEST IS YET TO BE, William G. Rose, Austin-Phelps, Inc., New York, 1951, 212 pages, $2.75.

One must have faith that the promise in the title will some day be fulfilled. This volume is not fulfilling. Nevertheless, it has its uses. It is half manual, half pep-talk; and there are times when this is precisely the indicated mixture.

It covers quite a territory. On page 109 we learn to keep a rug flat and non-skid by sewing to its underside "the rubber bands used at canning time around the neck of Mason jars." On page 119 a diet and menus are introduced. Social security benefits and community resources of various kinds are described. "Energy savers" are listed in a chapter on changing personal habits in later years. There is advice on overcoming handicaps, on dress, on over-anxiety, on study and learning. Almost all of this material is given in a direct, informal, almost gossipy style. There are lots of thumbnail anecdotes, including a few that are pointless — such as the one in which the author's college classmate was begged by the stout lady to help her out of her bathtub. (Moral: take sponge baths.)

The book seems to be designed for the aged per-

son and for those who live with them. It is not of stimulating interest to whoever does not so qualify.

L. TOWLEY

---

HOSPITAL IMPROVEMENTS. HOW TO IMPROVE THE DAILY LIFE OF THE PATIENT IN THE WARD, Written, illustrated, and published by Olive Matthews. 22 Harrington Gardens, London, S.W. 7, 32 pages, paper bound, price 1/6; 25 — 1/13/6; 50 — 3/2/6; 100 — 6/5/0.

This small paper bound pamphlet of 32 pages is a minor masterpiece of simplicity and conciseness. The aim of the ambitious title, "Hospital Improvements," is achieved through suggestions for the improvement of the service to the patient, who rightly becomes the focus of the hospital, its routines, its personnel, its structure and decoration, and its service. This is today the subject of other more elaborate theses, but few have succeeded with well chosen words and line drawings in going so directly to the heart of the matter and in pointing out so effectively how much little things count, how easily they may be done if imagination and the will to serve another human being in sickness motivate the planning and the doing. Although directed toward improving hospital life in Great Britain, this booklet should prove stimulating to nursing homes, homes for the aged, public and private, and hospitals in the United States and elsewhere.

O. A. RANDALL

---

SHOULD I RETIRE? by George H. Preston, Rinehart & Co., Inc., New York, 1952, 181 pages, $2.50.

Here is a straight-forward piece of good talk. Knowledgeable, balanced, hard-headed — indeed like one's personal physician talking turkey across his desk, but with leisure. It can be reported that here is a book for the aging reader that will not offend him with any of the pseudo mellowness and bluff heartiness that stales too many approaches to the senior citizenry.

Most of us can learn a great deal from Dr. Preston's discussion of "why do we work?" There's more to it than making a living, and some of the reasons offer a poor outlook for retirement. "You can never retire once you have started playing God." ". . . Overwork usually results from personality damage, is difficult to cure, and is almost always an absolute bar to retirement." "Unless a person has, by retirement time, learned to feel contented living inconspicuously, without the need for show, retirement may become a fretful, restless and unsatisfying time."

As to overworkers ("the dog with the tin can"), they will retire happily only if they can figure out how the can "is tied to them and then untie it." Retirement-mindedness is essential and must be cultivated for many years before quitting work.

Dr. Preston devotes a special chapter to women who retire, and another to the singular problems of the people who are single. He offers some plain facts about "homes" and institutional living. Hard facts here, as elsewhere, but necessary. The kind of body one takes into retirement and the danger signs to watch for as the years go on are presented in a calm manner that neither lulls nor threatens.

Body, mind, emotions, and environment are treated here as an interrelated whole. Nowhere is there a technical word, psychiatric or otherwise. It does not pull punches, nor wool over the eyes. Physicians might well take a look at this book as one to be recommended to some patients. May Dr. Preston improve his own retirement and our days with more of this kind of writing.

L. TOWLEY

# BOOKS RECEIVED

Books received since December 1, 1951, are acknowledged in the following list. In so far as space and time permit, some will be selected for review in a later issue, but it is unlikely that all will be reviewed.

*Adding Life to Years,* by Lord Amulree, National Council of Social Service, London, 1951, 101 pages, 14 illustrations (Reviewed in this issue, page 318).

*Anima,* vol. 6, no. 4, 1951, 385 pages (issue comprising 11 papers on the aged).

*Best Is Yet to Be,* by William G. Rose, Austin-Phelps, Inc., New York, 1951, 212 pages, $2.75 Reviewed in this issue, page 319).

*Changing Years: What to Do About the Menopause,* by Madeline Gray, Doubleday & Company, Inc., New York, 1951, 216 pages, $2.75 (Reviewed in this issue, page 318).

*Hospital Improvements: How to Improve the Daily Life of the Patient in the Ward,* written, illustrated, and published by Olive Matthews, 22 Harrington Gardens, London, S.W. 7, 1951, 32 pages, paper bound, price 1/6; 25 — 1/13/6; 50 — 3/2/6; 100 — 6/5/0 (Reviewed in this issue, page 320).

*Old Age and Retirement in Rural Connecticut. I. East Haddam: A Summer Resort Community,* bulletin 278, June, 1951, of the Storrs Agricultural Experiment Station, 46 pages, paper bound.

*Physical Medicine and Rehabilitation for the Aged,* by Walter S. McClellan, Charles C Thomas, Publisher, Springfield, Illinois, 1951, 81 pages, $2.00 (Reviewed in this issue, page 319).

*Social Contribution by the Aging,* edited by Clark Tibbitts, The Annals of the American Academy of Political and Social Science, vol. 279, January, 1952, 179 pages, $2.00 (Reviewed in this issue, page 319).

# INDEX TO CURRENT PERIODICAL LITERATURE

NATHAN W. SHOCK
*Gerontology Section*
*National Heart Institute*
*National Institutes of Health*

The subject categories are those in *A Classified Bibliography of Gerontology and Geriatrics* by Nathan W. Shock published by Stanford University Press, Stanford, California (1951). Only major headings are used and the Roman numerals correspond to those given in the bibliography. In so far as possible, references are classified according to organ systems. Thus most of the material on Geriatrics will be found under the organ system involved in the disease. Cross references are indicated by number at the end of each section. When available, abstract references are given *(B.A.—Biological Abstracts; P.A.—Psychological Abstracts;* and *P.I.—Population Index).* Abbreviations for journals are those used in *A World List of Scientific Periodicals Published in the years 1900-1933,* 2nd Edition. For journals not listed, abbreviations were devised according to the general rules used in the above source. It is impossible to cover all journals and list all papers concerned with aging and the aged. Authors and publishers are requested to call attention to publications or to send reprints to the Gerontology Section, Baltimore City Hospitals, Baltimore, Maryland. The assistance of the Forest Park Foundation, Peoria, Illinois, in the preparation of these materials is gratefully acknowledged.

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IV. MISCELLANEOUS: *Popular Articles*

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